4.3 DEVELOPMENT OF NSFR DATA BASE

The thirty sites photographed contained some 12,000 NSFR parcels (Table 4-1). Cursory examination of photographs of a few sites revealed that many parcels contained multiple buildings and that some buildings extended over multiple parcels. It became evident that a thorough examination of all NSFR parcels in the thirty sites was not feasible within the available resources for this project and that the expectation of single main building per parcel had to be modified to cope with the reality.

For this purpose, a new concept of "cluster" was introduced to accommodate buildings which extended over several parcels, as in large shopping centers, industrial complexes, and condominiums. To reduce the level of effort devoted to detailed examination of multiple buildings, a hybrid method was applied, based on exhaustive examination of a restricted number of parcels selected by statistical sampling:

1. Every odd numbered parcel was to be examined to obtain general description of the parcel; and

2. For statistically selected parcels, detailed measurements and identification of materials were to be carried out.

The first task was to generate a "parcel file", i.e., a file of general characteristics of NSFR parcels; the second task was to generate a "building file", i.e., a data file of detailed material-finishes found in all major building components in selected parcels or clusters. Discussions of these two data files are given in sections that follow.

4.3.1 PARCEL FILE

The purpose of the "Parcel File" was to generate a data base that described general features of parcels such as total land area, building footprint and building height. These features in conjunction with parcel use-type and construction type would provide a firmer data base from which a statistical sample of NSFR parcels for in-depth measurements of material-finishes would be selected.

In the parcel file phase, readily obtained measurements were carried out on all odd-numbered NSFR parcels. Features on each selected parcel were measured using both the black and white vertical photographs and the oblique Enviro-Pod photographs. Steps taken were:

- Perimeter measurement of the parcel and calculation of its area (in square meters)
- Perimeter measurement of each of the buildings in the parcel; the obliques were consulted to determine the number and location of each building in the parcel. The area of the buildings was then calculated.
- Area was also calculated for ground surfaces of: concrete, asphalt, non-built-upon landscaping, etc.
- Reference to the oblique photographs provided information on which to determine the height of the tallest building and the average building height (in meters).
- Total building floor area was calculated after determining the number of floors from the oblique photographs (which revealed the sides of buildings) for use as a multiplier.

In developing a parcel file, detailed instructions for recording the measured data onto a specially designed coding sheet were developed. Both the instructions and coding sheet are presented in Appendix H. A special aspect of the instructions is how to handle parcels in a cluster. Unlike SFR parcels, many NSFR parcels show either a large building over several parcels, several buildings in one parcel or several buildings over a few parcels.

In the NAPAP study (Merry 1986), buildings over boundaries of footprints (the sampling unit used in that study) were either only partially inventoried or totally excluded from the inventory. To avoid such partial coverage, this study applied the "cluster" concept. Specifically, a more general unit called a "cluster" overrode the basic unit of a parcel. For normal situations, 1 cluster equaled 1 parcel. For other situations, a cluster was used to

represent a contiguous area of parcels over which one or more buildings were found.

As described in Appendix H - General Instructions for NSFR Parcel File and Revision, a data record for each cluster includes the number of parcels in the cluster, cluster total area, building footprint, ground cover, the number of buildings, average and tallest building heights, and total floor area as well as the I.D. number and use-type of the parcel in which a dominant building is situated. In total, such records were prepared for 5005 clusters containing 7541 parcels.

Table 4-3 shows summary counts of clusters and parcels by use-type in the parcel file data base. The table indicates that in each use-type there are a few parcels having no corresponding buildings and that the number of such parcels per cluster varies considerably from one use-type to another. As anticipated, the use-type VAC exhibits the highest percentage of parcels without corresponding buildings: 53 percent in Los Angeles and 87 percent in Composite County. The other use-types having a relatively high percentage of parcels without corresponding buildings are: SNR with 39 percent and LNR, MJR and NNK each with 8 percent in Los Angeles; and in Composite, UNK, AGR, NR and RCOND, respectively with 49, 29, 15 and 9 percent.

In terms of the number of parcels per cluster, RCOND exhibits the largest number of parcels, as anticipated: 17 in Los Angeles and 22 in Composite. Use-types with relatively large numbers of parcels are: UNK with 6 and VAC with 2 in Los Angeles; and UNK with 2 in Composite. All other use-types exhibit a moderate ratio of 1.0 to 1.5 parcels per cluster.

For those clusters with buildings, the parcel file records also indicate the construction type of the dominant buildings in the cluster: wooden post and lintel (Wood), unit masonry (Mason), concrete (Concrete), and reinforced concrete frame (Frame). "Wood" is a wooden frame structure whereas "Masonry" is an old fashioned building made of brick or block. "Concrete" is a structure commonly used for warehouse and factory buildings. "Frame" is often found in modern highrise buildings.

TABLE 4-3. SUMMARY RESULTS OF PARCEL FILE DATA OF 7541 NSFR PARCELS IN THE 30 STUDY SITES

Use - and Construction Type	All Clusters #Clusters	All Clusters #Parcels	Clusters w/ Bldgs #Clusters	Clusters w/ Bldgs #Parcels	#Ps/C	Percent Parcels w/o Bldg
L.A. Use-Type						
SMFR	599	627	593	620	1.05	1.1
LMFR	576	612	571	605	1.06	1.0
RCOND	82	1267	76	1261	16.59	0.5
SNR	215	319	133	194	1.46	39.2
LNR	1078	1283	998	1174	1.18	8.5
MJR	268	330	248	302	1.22	8.5
UNK	3	13	2	12	6.00	7.7
VAC	159	319	68	150	2.21	53.0
L.A. Total	2980	4770	2689	4318	1.61	9.5
L.A. Construction Type						
Wood			1515	2762	1.82	
Mason			740	903	1.22	
Concrete			276	403	1.46	
Frame			158	250	1.58	
COMP Use-Type						
MFR	500	526	491	517	1.05	1.7
RCOND	30	626	26	573	22.04	8.5
MH	7	7	6	6	1.00	1.4
NR	886	976	741	834	1.13	14.5
AGR	7	7	5	5	1.00	28.6
UNK	28	39	10	20	2.00	48.7
VAC	567	587	60	75	1.25	87.2
COMP Total	2025	2771	1339	2030	1.52	26.7
COMP Construction Type						
Wood			804	1394	1.73	
Mason			354	383	1.08	
Concrete			139	206	1.48	
Frame			42	47	1.12	
SoCAB Total	5005	7541	4028	6348	1.58	15.8

Table 4-4 shows summary features of buildings in NSFR parcels of various use-types found in the parcel file sample. Buildings in UNK are the tallest

(33 feet in average height) and have the largest floor space (33,625 ft^2) among the eight different use-types in Los Angeles County. Buildings in MJR have the largest building footprint (21,099 ft^2) and the second largest floor space (27,411 ft^2). At the other extreme, RCOND exhibits the smallest area in both building footprint and floor space, although the average building is rather tall, 23 feet as compared to the Los Angeles County average of 20 feet.

The reason for these small building footprints and floor areas in RCOND is that many parcels are involved in one condominium building or complex. Indeed, there were as many as 17 parcels per RCOND cluster, resulting in only 0.3 building per parcel. On a cluster basis, condominium buildings have, on average, 27,514 ft^2 in building footprint and 56,414 ft^2 in floor space.

The large areas indicated in Table 4-4 for footprints and floor of mobile home parcels reflect the fact that, in Composite County, mobile home parks (rather than individual mobile homes) are recorded as parcels. The numbers shown, therefore, represent the average total area of all mobile homes in one mobile home park in Composite County. In Los Angeles County, "mobile homes" is not a land use recognized by the assessor.

The number of mobile homes in a mobile home park can vary from time to time and, of course, from park to park. In the airphoto used in this study, we identified seven mobile home parks and found in them the following numbers of mobile home units: 40, 133, 22, none, 48, 24 and 35. These numbers agreed reasonably well with auxiliary information from the Orange County assessor, and VRC has relied on them as an adequate sample for scaling up to the mobile home population in the SoCAB.

Among the four construction types considered, "Concrete" has the largest building footprint in both Los Angeles and Composite counties whereas "Frame" has a larger floor space than "Concrete" in Los Angeles County. At the other extreme, "Wood" has the smallest building footprint on a parcel basis with 4,333 ft^2 in Los Angeles County and 8,679 ft^2 in Composite County. On a cluster basis, however, "Mason" has a small or building footprint and floor space than "Wood" in Composite County.

TABLE 4-4. MEAN VALUE OF MAJOR FEATURES OF BUILDINGS IN THE PARCEL FILE SAMPLE (Areas in ft^2/parcel and height in feet).

Use- and Construction Type	# Parcels w/ bldg	# Bldg per Prcl	Bldg Footprint	Floor Space	Avg. Height	Tallest Bldg
L.A. Use-Type						
SMFR	620	2	4838	6558	13	13
LMFR	605	2	8920	17016	20	20
RCOND	1261	0.3	1658	3400	23	26
SNR	194	4	13076	13615	16	16
LNR	1174	2	13167	16910	16	16
MJR	302	2	21099	27411	16	16
UNK	12	0.3	8816	33625	33	43
VAC	150	1	5802	7437	16	20
L.A. Avg.	4318*	1	8299	11798	16	16
L.A. Construction Type						
Wood	2762	1	4333	7180	16	16
Mason	903	2	10082	10920	16	16
Concrete	403	1	22609	24180	20	20
Frame	250	3	22375	46021	20	23
COMP Use-Type						
MFR	517	2	11848	19412	20	20
RCOND	573	0.7	4023	7685	23	23
MH	6	50	178521**	178521**	10	10
NR	834	2	15168	19870	16	16
AGR	5	4	25887	25887	16	16
UNK	20	2	8014	8633	16	16
VAC	75	2	9886	13304	16	16
COMP Avg	2030*	3	11424	15535	16	16
COMP Construction Type						
Wood	1394	1.5	8679	13205	16	16
Mason	383	2	11730	12983	16	16
Concrete	206	2	28420	33127	20	20
Frame	47	2	15919	28289	20	20
SoCAB Avg	6348*	1	9296	12991	16	16

* Total number of parcels with buildings.

** These values are adjusted in subsequent analysis as discussed in the text.

On basinwide averages, NSFR parcels have 9,296 ft^2 in building footprint, 12,991 ft^2 in floor space, and 16 feet in average height. NSFR parcels contain, on average, 1.6 buildings per parcel and 2.5 buildings per cluster. As compared to a typical SFR parcel, having a 1-story house with 1500 ft^2 in floor space, the average NSFR parcel is approximately 6 and 9 times as large in building footprint and floor space as the SFR, and has an equivalent height of 1.5 to 2 stories.

4.3.2 BUILDING FILE

Parcels analyzed in the building file phase were selected according to a stratified random sampling method, from those parcels which were found to contain at least one building in the parcel file phase. Since records in the parcel file data base were given for each identified cluster instead of a parcel, sampling was done in proportion to the number of clusters in each use-type and construction type in the parcel file data base. To appropriately represent all use types and construction types in the sample, at least one cluster was selected from each use/construction type combination which was present in the parcel file.

Table 4-5 compares the numbers of clusters and parcels included in the parcel file sample with those of the building file sample. The table shows that although proportions of clusters in each use-type and construction type in the building file sample are nearly identical with those for the parcel file sample, parcel proportions in the two samples are noticeably different. This happened probably because some use-types or construction types were more clustered (i.e., more parcels per cluster) than others.

TABLE 4-5. NUMBER OF CLUSTERS AND PARCELS WITH BUILDING FOUND IN THE PARCEL AND BUILDING FILE SAMPLES

Use- and Construction Type	Parcel File				Building File			
	#Clusters	#Parcels	%Clstr	%Prcl	#Clusters	#Parcels	%Clstr	%Prcl
L.A. Use-Type								
SMFR	593	620	14.7	9.8	128	133	14.9	9.3
LMFR	571	605	14.2	9.5	130	139	15.2	9.7
RCOND	76	1261	1.9	19.9	16	352	1.9	24.6
SNR	133	194	3.3	3.1	28	49	3.3	3.4
LNR	998	1174	2.5	18.5	209	246	24.4	17.2
MJR	248	302	6.2	4.8	57	76	6.6	5.3
UNK	2	12	0.0	0.2	1	11	0.1	0.8
VAC	68	150	1.7	2.4	15	44	1.7	3.1
L.A. Total	2689	4318	66.8	68.0	584	1050	68.1	73.5
L.A. Construction Type								
Wood	1515	2762	37.6	43.5	330	644	38.5	45.1
Mason	740	903	18.4	14.2	160	212	18.6	14.8
Concrete	276	403	6.9	6.3	63	125	7.3	8.7
Frame	158	250	3.9	3.9	31	69	3.6	4.8
COMP Use-Type								
MFR	491	517	12.2	8.1	101	111	11.8	7.8
RCOND	26	573	0.6	9.0	6	92	0.7	6.4
MH	6	6	0.1	0.1	1	1	0.1	0.1
NR	741	834	18.4	13.1	152	160	17.7	11.2
AGR	5	5	0.1	0.1	1	1	0.1	0.1
UNK	10	20	0.2	0.3	3	3	0.3	0.2
VAC	60	75	1.5	1.2	10	11	1.2	0.8
COMP Total	1339	2030	33.2	32.0	274	379	31.9	26.5
COMP Construction Type								
Wood	804	1394	20.0	22.0	164	261	19.1	18.3
Mason	354	383	8.8	6.0	77	81	9.0	5.7
Concrete	139	206	3.5	3.2	26	30	3.0	2.1
Frame	42	47	1.0	0.7	7	7	0.8	0.5
SoCAB Total	4028	6348	100.0	100.0	858	1429	100.0	100.0

The purpose of the "Building File" was to generate material-finish data for a representative sample of NSFR parcels by applying state-of-the-art airphoto analysis to those parcels selected for the sample. Unlike the parcel file phase, the building file phase was directed to quantitative interpretation of all detectable features of buildings and other structures. The heart of the photo-interpretation and building materials inventory phase of the work involved the identification and measurement of these features through use of the low altitude, oblique air photographs taken using the Enviro-Pod system.

Each selected parcel was examined intensively. All structures were noted, identified, and measured. Subdivisions (called elements here) of roofs and walls were given individual measurements. This occurred when a roof or wall would have more than one type of building material; a common occurrence with roofs would be where part was made of composition materials and part of another material, tile, for instance. Walls almost always consisted of several materials. Each measurement required certain steps and techniques.

For roof materials, measurement was first made of each roof perimeter (on the vertical photograph); allowance was made for the pitch of the roof in area calculation. Roof elements were measured individually for all items listed in the SFR coding sheet (see Appendix B).

Walls and wall elements were then measured. The height of walls, an essential ingredient in measurement, was calculated on the basis of interpretation of various types and sizes of building; allowances for height were made accordingly. The height assigned a wall of an apartment building was 3 meters per story. Heights per floor of commercial and industrial buildings were greater; the standard for "tilt-up" construction industrial/storage buildings, for example, is 5 to 6 meters. Wall heights were used in measuring the total wall area (perimeter times height).

The type of wall material was determined in part from direct observation of texture and color and partly from the type of material to be anticipated through reference to contextual information from the branching key (Figure 4-7). The key directed the interpreter first to the general construction type; certain wall materials are associated with each of the types listed.

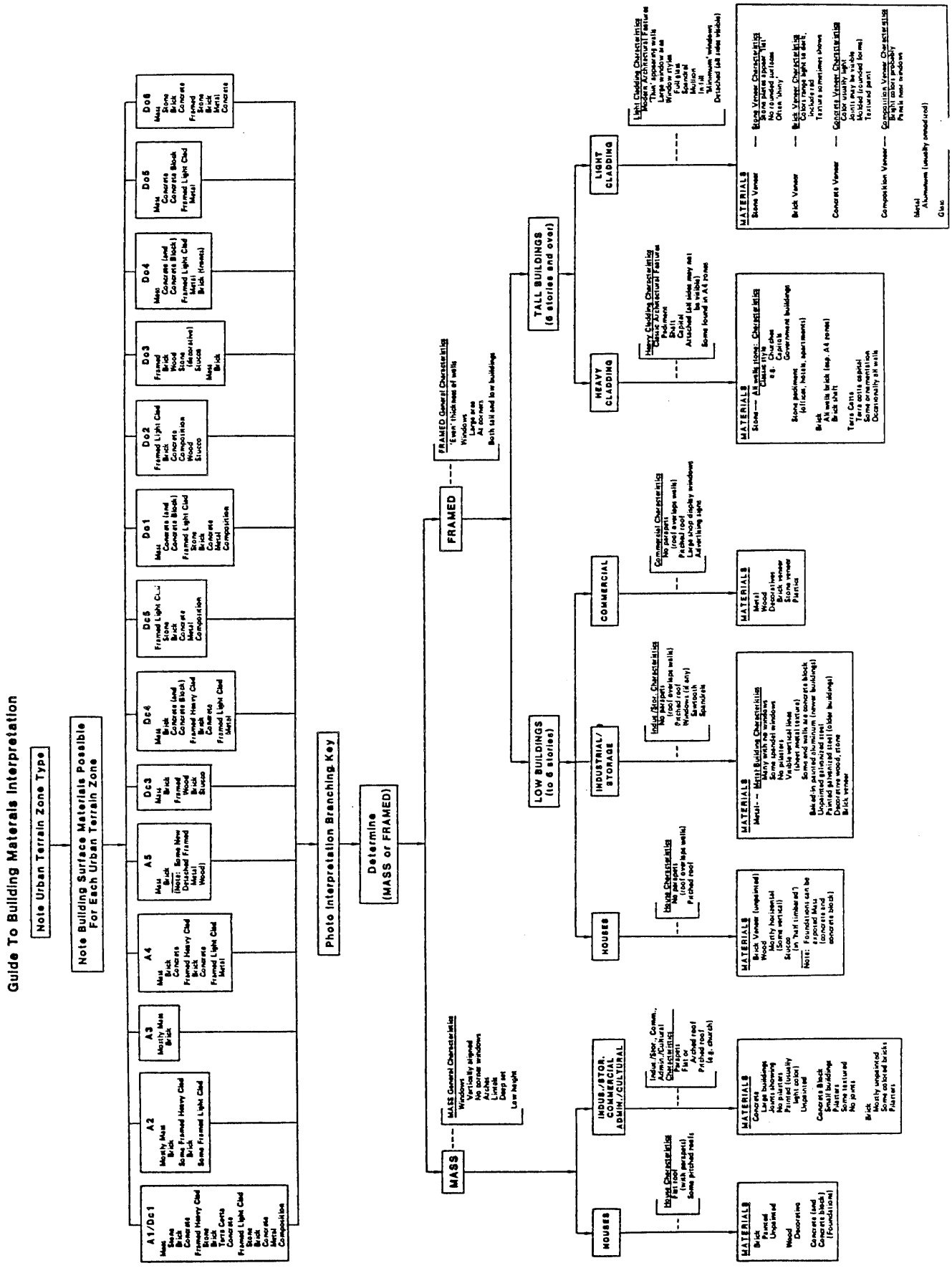

Figure 4-7. Guide to Use of Branching Key in Identifying Building Materials

Upon identifying the general type of the building and its use, the list of possible wall materials was reduced to a point where identification of the specific type was greatly simplified.

The finish of the material was then determined. Many surfaces were always painted, e.g., stucco. Others, such as concrete, are sometimes painted and sometimes left bare. The same is true for brick surfaces.

In addition to the common wall elements of glass, wood, and metal, some buildings have several wall materials. The four-direction coverage by the Enviro-Pod camera was very useful in permitting such identifications.

Soffits, or the underside of porch roofs, balconies, and the like were also recorded although, of course, they could not be viewed directly. However, a sufficient number of field observations were made to make reliable estimates of the expected nature of soffit materials.

Items identified and measured directly were those appearing on roof tops and at various points in the parcels. Readily seen and counted on roofs were such features as air conditioners, vents, skylights, and chimneys. (Restaurants have extensive air conditioning and venting features; they are commonly and intentionally hidden from street observation by Mansard roof treatments.)

Attention was given to fence building material and height; a total of 16 types was recorded:

1. Tall (2m) block
2. Short (1m) block
3. Tall (2m) block with wire
4. Short (1m) block with wire
5. Tall (2m) wood
6. Short (1m) wood
7. Tall (2m) "cyclone" wire
8. Short (1m) "cyclone" wire
9. Tall (2m) steel
10. Short (1m) steel
11. Tall (2m) fiberglass
12. Short (1m) fiberglass
13. Tall (2m) Wrought iron
14. Short (1m) Wrought iron
15. Tall (2m) Wood with wire
16. Short (1m) Wood with wire

Their length was measured and half of it was assigned to each bordering parcel in the calculation of area. Length was multiplied by height to give area in square meters.

Other features noted and counted were: solar panels, utility poles, television antennas, satellite dishes, signs, tanks, and sheds.

Throughout the entire photo interpretation process, identifications were checked in visits to the field. This interactive "ground truthing" served to confirm identifications made and to provide clues to aid in the interpretation of building material look-alikes. Visiting the field with the photographs in hand and comparing the photo image to the building represented helped subsequent interpretations in the laboratory; patterns and similarities were quickly seen. These observations were used in conjunction with the information on the branching key.

4.4 MATERIALS IN NSFR PARCELS

An inventory of materials associated with NSFRs was developed using both the parcel and building file data bases. Like the SFR material-finish inventory discussed in Section 3.0, the NSFR inventory was estimated for parcel total, building primary, roof, wall, etc. However, leaving details of such inventories for use of ARB and other professionals, this report focuses on overall aspects of NSFR-associated materials: material-finish mixes by NSFR use and construction types; and county and basinwide inventories of materials associated with NSFRs.

4.4.1 MATERIALS-IN-PLACE FOR NSFRs IN BUILDING FILE SAMPLE

For the building file sample, detailed measurements and material-finish identifications were carried out for 858 clusters containing 1429 NSFR parcels. All items measured and identified in the building file phase were encoded using a specially designed coding sheet, which was quite similar to the one used for SFR data (see Appendix F). The only difference between the SFR and NSFR coding sheets was the omission of secondary elements for windows and doors in the latter. Because of a limited resolution in aerial photographs, the secondary elements such as window screens, security bars and screen doors were not identified.

Table 4-6 shows mean exposed surface areas of various material-finishes found in NSFR parcels for eight different use-types in Los Angeles County:

SMFR = Small multi-family residences (triplex and fourplex);

LMFR = Large multi-family residences (5 or more units);

RCOND = Residential condominium;

SNR = Small nonresidential parcels such as service stations, nurseries, parking lots, etc.;

LNR = Large nonresidential parcels, including all nonresidential parcels except those found in SNR and MJR;

MJR = Major properties identified by Los Angeles tax assessor office;

UNK = Parcels with unknown use; and

VAC = Vacant lot.

Although all NSFR measurements were made in metric units, original data values were converted to English units for ease of comparisons with results of SFRs and infrastructures.

Total exposed surface areas for NSFR parcels are, in general, considerably larger than those of SFRs: 18,500 to 41,000 ft^2 (except for RCOND and VAC) per NSFR parcel versus 8,700 to 9,800 ft^2 per SFR parcel (see Table 3-15). Among the eight use-types, MJR has the largest surface area, 41,000 ft^2 whereas VAC and RCOND are the two smallest with 5,800 ft^2 and 3,000 ft^2, respectively. Many VAC clusters consisted of multiple parcels which served as parking lots, with only tiny buildings. The small surface area for RCOND was due to the assessors' designation of the holdings of individual owners as parcels instead of a land-based parcel. This is evident from the fact that there were 352 parcels over the 16 clusters identified for RCOND (see Table 4-6).

TABLE 4-6. MEAN EXPOSED SURFACE AREAS BY MATERIAL-FINISH FOR EIGHT NSFR USE-TYPES IN LOS ANGELES COUNTY (All values in ft^2/parcel)

Material-Finish		SMFR 128* 133**	LMFR 130 139	RCOND 16 352	SNR 28 49	LNR 209 246	MJR 57 76	UNK 1 11	VAC 15 44
111	Block - Bare	208	315	15	282	240	620	91	168
112	Block - Painted	217	343	15	1320	1789	1773	91	211
121	Brick - Bare	9	16	14	41	721	2938	-	-
122	Brick - Painted	-	-	-	-	246	20	-	-
131	Concrete - Bare	887	1284	179	1178	4289	5188	8059	1639
132	Concrete - Painted	-	-	49	10^69	811	152	1502	27
142	Stucco - Painted	4487	8091	1082	603	1563	866	-	120
151	Tile - Bare	-	-	-	-	-	-	-	-
161	Terra Cotta - Bare	57	158	16	179	86	73	-	
162	Terra Cotta - Painted	-	-	-	-	10	-	-	-
311	Fieldstone - Bare	1	-	-	-	-	-	-	-
321	Granite - Bare	-	-	-	-	-	-	68	-
351	Volcanic - Bare	-	-	-	-	-	-	-	-
411	Aluminum - Bare	1	0	2	3	3	4	-	5
412	Aluminum - Painted	27	5	-	2533	60	20	-	35
441	Steel - Bare	-	9	-	24	169	136	-	44
442	Steel - Painted	12	46	5	880	527	788	87	19
451	Galvanized Steel - Bare	16	23	7	51	98	115	75	9
462	Iron - Painted	1	-	-	-	-	-	-	-
471	Chain Link - Bare	73	9	-	277	360	324	-	223
591	Unspecified Metal - Bare	4	2	-	78	293	225	-	14
592	Unspecified Metal - Painted	5	9	-	2663	82	65	-	9
711	Wood - Bare	360	181	124	204	51	12	-	81
712	Wood - Painted	772	10^69	66	179	144	86	-	-
714	Wood - Varnish	-	-	-	-	-	-	-	5
715	Wood - Stained	360	181	124	198	48	12	-	-
721	Wood Shingle - Bare	101	206	-	116	3	-	-	-
722	Wood Shingle - Painted	-	30	1	14	6	-	-	-
731	Plastic - Bare	3	2	1	30	48	49	-	48
732	Plastic - Painted	-	-	-	-	-	-	-	-
761	Asphalt - Bare	628	1432	60	8222	8711	12210	-	875
771	Asphalt Roofing - Bare	4686	8497	1081	6156	11049	15087	5960	2092
781	Glass - Bare	641	1069	150	437	478	275	2561	47
782	Glass - Painted	-	7	-	-	3	-	-	-
791	Fiberglass - Bare	10	-	-	413	-	-	-	61
	Total Area	13567	22984	2993	27143	31896	41041	18491	5787

* Number of clusters of designated use-type in the building file sample.

** Number of parcels of designated use-type in the building file sample.

As anticipated from the use-type definitions, LMFR has a larger surface area than SMFR: 23,000 ft^2 vs. 14,000 ft^2. Similarly, MJR has the largest surface area among the three nonresidential categories: 41,000 ft^2 for MJR, 32,000 ft^2 for LNR, and 27,000 ft^2 for SNR. In terms of materials, asphalt is abundant in all use-type because it is used for roofing material (e.g., asphalt shingle and asphalt roll) and ground cover (e.g., asphalt-base). Concrete is found in both ground cover and wall while block is found in wall and fence.

As in SFRs, painted stucco is found in large quantity for wall materials, particularly of residential buildings, SMFRs, LMFRs and RCONDS. On the other hand, painted metals are found in significant quantities for wall materials of nonresidential buildings in SNR, LNR and MJR parcels.

Table 4-7 shows mean exposed surface areas by material-finish for NSFR use-types in Composite County. As in Los Angeles County, this table also indicates that painted stucco is found in larger quantity in residential parcels of MFR and RCOND than in nonresidential parcels of NR. On the other hand, bare and painted metals are found primarily in nonresidential parcels. UNK and VAC use-types of Composite County appear to be different from their Los Angeles counterparts. UNK has the largest exposed area (41,500 ft^2) among the seven use-types while VAC has the third largest (26,000 ft^2). In Composite County, most tax-exempt properties like governmental buildings and academic institutions appear to be grouped into this UNK category whereas in Los Angeles County, they are grouped into either LNR or MJR.

Unlike Los Angeles County, Composite County parcels are designated VAC not only for parking lots but also for some major buildings. A reason for this may be that in Composite county some VAC parcels are less quickly updated when their use is changed. A more convincing reason may be found in the fact that the proportion of VAC parcels without buildings to the total number of VAC parcels is very much higher in Composite County than in Los Angeles County (87 percent vs. 53 percent, as shown in Table 4-3). Therefore, even a few un-updated VAC parcels that now have buildings would greatly increase the total exposed VAC area in Composite County, whereas in Los Angeles County such un-updated VAC parcels would not produce the same effect because so many VAC parcels are in use for parking lots.

TABLE 4-7. MEAN EXPOSED SURFACE AREAS BY MATERIAL-FINISH FOR SEVEN NSFR USE-TYPES IN COMPOSITE COUNTY (All values in ft^2/parcel)

Material-Finish		MRF 101* 111**	RCOND 6 92	NR 152 160	UNK 3 3	VAC 10 11	AGR 1 1	MH*** 1 40
111	Block - Bare	123	143	470	415	232	1748	79
112	Block - Painted	228	141	1643	415	457	1744	79
121	Brick - Bare	10	23	53	929	3	39	-
122	Brick - Painted	-	-	68	-	-	-	-
131	Concrete - Bare	1282	2098	2333	12175	1257	-	235
132	Concrete - Painted	-	-	1737	-	661	-	-
142	Stucco - Painted	8756	3681	1745	817	1546	6029	90
151	Tile - Bare	-	-	-	-	-	-	-
161	Terra Cotta - Bare	103	-	451	-	176	-	-
162	Terra Cotta - Painted	-	-	-	-	-	-	-
311	Fieldstone - Bare	8	-	4	-	-	-	-
321	Granite - Bare	-	-	-	-	-	-	-
351	Volcanic - Bare	-	-	-	-	-	-	-
411	Aluminum - Bare	-	-	4	-	3	-	-
412	Aluminum - Painted	-	-	80	-	-	-	2969
441	Steel - Bare	-	-	250	-	261	647	-
442	Steel - Painted	10	33	637	-	431	-	1
451	Galvanized Steel - Bare	8	37	10^6	-	70	21	1
462	Iron - Painted	5	-	-	-	-	-	-
471	Chain Link - Bare	18	-	429	1642	8	-	-
591	Unspecified Metal - Bare	10	-	209	593	656	301	1336
592	Unspecified Metal - Painted	-	-	618	-	-	-	-
711	Wood - Bare	423	98	95	-	111	-	-
712	Wood - Painted	666	2072	303	1758	243	732	62
714	Wood - Varnish	-	-	-	-	-	-	-
715	Wood - Stained	423	98	95	-	111	-	-
721	Wood Shingle - Bare	458	2890	80	4801	-	-	93
722	Wood Shingle - Painted	25	-	11	-	-	-	-
731	Plastic - Bare	-	-	68	-	26	-	-
732	Plastic - Painted	-	-	4	-	8	-	-
761	Asphalt - Bare	2669	2616	15118	15446	12995	-	469
771	Asphalt Roofing - Bare	8776	2604	10535	1285	5583	8697	2776
781	Glass - Bare	1039	896	785	1181	958	775	193
782	Glass - Painted	-	-	-	-	23	-	-
791	Fiberglass - Bare	-	-	-	-	-	-	98
	Total Area	25038	17429	37937	41455	25810	20731	8484

* The number of clusters of designated use-type in the building file sample.

** The number of parcels of designated use-type in the building file sample.

*** The number of units found in the cluster is used instead of the number of parcels as discussed in the text.

Estimates of exposed material surfaces for AGR and MH parcels were based on single cluster data. It is rather dangerous to draw any definitive conclusion from a single study case. Therefore, the records for AGR and MH were carefully examined by comparing them with larger numbers of cases (7 clusters each for AGR and MH) studied in the parcel file. Over the seven clusters of MH, 302 mobile home units were found, with the average of 43 units per cluster. The single cluster studied in the building file was found to contain 40 mobile home units. Thus, it was concluded that this cluster was reasonably representative of MH clusters. As discussed in Section 4.3.1, the number of mobile home units was utilized in place of the number of MH parcels in the cluster.

There were seven clusters of AGR in the parcel file of which five had buildings. The number of buildings in the seven clusters are:

AGR Clusters	Number of Buildings
1st	0
2nd	5
3rd	2
4th	4
5th	6
6th	0
7th	3
Total	20

The cluster in the building file is the 7th cluster, which happens to have the same number of buildings as the average number of buildings per cluster. Therefore, this cluster was also considered to be a representative one.

Table 4-8 shows mean exposed surface ares by material-finish for the four construction types which the airphoto analysts at SJSU determined for a dominant building in every cluster examined in the building file phase. Among the four construction types, wood post and lintel (Wood) is by far the commonest, accounting for 61 percent of all NSFR parcels in Los Angeles County and 72 percent in Composite County. Unit masonry (Masonry) is the second commonest, followed by "Concrete" and reinforced concrete frame (Frame) in both counties.

TABLE 4-8. MEAN EXPOSED SURFACE AREAS BY MATERIAL-FINISH FOR FOUR CONSTRUCTION TYPES IDENTIFIED BY AIRPHOTO ANALYSTS (All values in ft^2/parcel)

		Los Angeles County					Composite County***				
		Wood	Masonry	Concrete	Frame	L.A.	Wood	Masonry	Concrete	Frame	COMP
		330*	160	63	31	584	164	77	26	7	274
	Material-Finish	644**	212	125	69	1050	300	81	30	7	418
111	Block - Bare	136	207	264	888	207	193	413	615	202	268
112	Block - Painted	183	2190	951	751	710	278	1945	2066	1583	752
121	Brick - Bare	18	793	1111	1565	391	14	74	135	-	35
122	Brick - Painted	3	130	170	134	56	-	136	-	-	27
131	Concrete - Bare	627	2394	5827	8370	2037	1422	933	8801	698	1846
132	Concrete - Painted	50	752	442	885	285	10	1579	5208	-	687
142	Stucco - Painted	3195	796	1921	2185	2471	4908	851	2585	420	3877
151	Tile - Bare	-	-	-	-	-	-	-	-	-	-
161	Terra Cotta - Bare	32	70	119	453	73	95	249	1220	61	205
162	Terra Cotta - Painted	-	-	22	-	2	-	-	-	-	-
311	Fieldstone - Bare	-	-	-	-	-	6	-	-	-	3
321	Granite - Bare	-	-	-	11	-	-	-	-	-	-
351	Volcanic - Bare	-	-	-	-	-	-	3	-	-	-
411	Aluminum - Bare	1	2	7	-	2	-	3	10	-	3
412	Aluminum - Painted	171	168	11	26	143	397	82	202	-	315
441	Steel - Bare	14	89	82	360	57	40	85	461	1704	105
442	Steel - Painted	55	464	268	1319	234	44	310	2133	1375	267
451	Galvanized Steel - Bare	17	89	85	85	44	16	97	298	81	54
462	Iron - Painted	-	-	-	-	-	2	3	-	-	3
471	Chain Link - Bare	70	264	346	327	155	137	144	644	581	183
591	Unspecified Metal - Bare	48	82	-	803	91	236	149	-	2113	234
592	Unspecified Metal - Painted	100	115	-	1174	152	-	156	2325	2508	237
711	Wood - Bare	202	36	15	11	134	210	54	-	678	172
712	Wood - Painted	471	55	37	245	318	1030	159	77	81	776
714	Wood - Varnish	-	-	4	-	-	-	-	-	-	-
715	Wood - Stained	201	34	15	4	132	210	54	-	678	172
721	Wood Shingle - Bare	65	2	-	93	46	1086	41	615	-	833
722	Wood Shingle - Painted	6	10	-	11	5	10	21	-	-	11
731	Plastic - Bare	5	48	85	7	22	-	36	259	40	27
732	Plastic - Painted	-	-	-	-	-	-	5	19	-	3
761	Asphalt - Bare	1560	5877	8544	9466	3692	3351	10783	36328	30650	7609
771	Asphalt Roofing - Bare	3569	8930	16297	7147	6335	5372	6805	30150	4217	7407
781	Glass - Bare	458	339	502	836	457	770	472	1912	2892	830
782	Glass - Painted	2	2	-	-	2	-	-	-	-	-
791	Fiberglass - Bare	12	96	-	-	27	14	-	-	-	11
	Total Area	11274	24037	37165	31936	18288	19854	25630	96082	50561	26946

* The number of clusters of designated use-type in the building file sample.

** The number of parcels of designated use-type in the building file sample.

*** The number of parcels is adjusted for the anomaly in MH parcels as discussed in the text.

In terms of total exposed material surface per parcel, "Concrete" is the first with 37,000 ft^2 in Los Angeles County and 96,000 ft^2 in Composite county. "Concrete" is found in most warehouse type buildings. "Frame" has the second largest exposed surface, with 32,000 ft^2 and 51,000 ft^2 respectively in the two counties. "Wood" has the smallest exposed surface with 11,000 ft^2 and 20,000 ft^2, respectively. On average over all construction types, buildings in Los Angeles County are considerably smaller than those of Composite County: 18,000 vs. 27,000 ft^2 per parcel.

As to material-finishes, all construction-types have large amounts of bare asphalt and concrete in ground cover and of asphalt shingle and roll in roof. For wall materials, "Wood" is dominated by painted stucco. "Concrete" uses both painted stucco and bare brick whereas "Frame" uses painted steel as well as stucco and brick. "Masonry" uses painted block for its wall. Unlike for SFRs, wood material-finishes (e.g., wood shingle and painted/bare wood) are not found in large quantities for NSFRs with any construction types.

Table 4-9 shows mean exposed material surface areas by components: roof, roof features, soffit, wall, and ground. Among the five components, "Roof" has the largest exposed area in Los Angeles County but in Composite County, "Ground" has the largest exposed area, indicating that NSFRs, there, are in more spacious lots than in Los Angeles County. "Wall" is in the third place among the five components in both counties. As anticipated, "Roof features" has by far the smallest exposed area.

As to aggregated components, "All roof" accounts for 39 percent of parcel total in Los Angeles and 34 percent in Composite. "Building primary" (roof, soffit and wall) accounts for, respectively, 68 percent and 62 percent of parcel total in the two counties.

TABLE 4-9. MEAN EXPOSED SURFACE AREAS BY NSFR PARCEL COMPONENT IN LOS ANGELES, COMPOSITE AND SoCAB (All values in ft^2/parcel)

Component	Los Angeles 584/1050[a]	Composite 274/418	SoCAB 858/1468
Individual Component			
Roof	6953	8924	7515
Roof Features[b]	97	131	107
Soffit	314	731	433
Wall[c]	5248	7112	5779
Ground[d]	5675	10050	6918
Aggregated Component			
All Roof	7050	9055	7622
Bldg Primary	12516	16765	13727
Bldg Total	12613	16896	13834
Parcel Total	18288	26946	20752

Note: All roof = Roof + Roof features

Bldg primary = Roof + Soffit + Wall

Bldg total = Bldg primary + Roof features

Parcel total = Bldg total + Ground

[a] The number of clusters and parcels in the building file sample. The numbers of parcels in Composite County and SoCAB are adjusted for the anomaly in MH parcels as discussed in the text.

[b] Include chimneys, sky lights, vents and A/C units.

[c] Include windows and doors as well as basic wall.

[d] Include ground covers, fences and minor structures.

4.4.2 BASINWIDE INVENTORY OF MATERIALS ASSOCIATED WITH NSFRs

Due to the exclusion of parcels without buildings from the sample, proportions of various NSFR use-types in the building file sample were somewhat different from those of the NSFR parcel population in the SoCAB. Therefore, all extrapolations from the airphoto analysis results to the SoCAB were made separately for individual sampling strata defined by NSFR use-types. Since the building file sample consists of only those parcels with buildings, the

numbers of parcels with buildings in the SoCAB must be estimated for every NSFR use-type prior to any attempt to extrapolate the analysis results to the basin. For this purpose, Table 4-10 was prepared.

In Table 4-10, the number of NSFR parcels with buildings in each use-type is estimated from the product of the total number of parcels for that use-type and the percentage of parcels with buildings, which was computed from results of the parcel file sample (see Table 4-3). Owing to the large percentages of parcels without buildings, the number of VAC parcels with buildings are estimated to be considerably smaller than the original numbers of VAC parcels: 60,000 vs. 127,000 in Los Angeles County and 26,000 vs. 206,000 in Composite County. Similar reductions are seen for SNR parcels in Los Angeles County and UNK and AGR parcels in Composite County. Basinwide, the total number of NSFR parcels with buildings is estimated to be 808,000, compared to 1.1 million for all NSFR parcels.

Table 4-11 shows total exposed surface areas by material-finish for all nine NSFR use-types in Los Angeles County. All estimates were made for each use-type separately, by multiplying the exposed surface areas per parcel (see Table 4-6) with the number of parcels with buildings, which is given in Table 4-10.

Among the nine NSFR use-types, LNR has the largest exposed material surface, 3.5 billion ft^2, followed by LMFR with 1.4 billion ft^2, and SMFR and MJR with 0.9 billion ft^2 each. Although RCOND parcels are the most numerous among the use types, they are in the fifth place with 0.5 billion ft^2 because of the fictitious counting of condominium owners as parcels. Mobile homes (MH), which are ranked a respectable sixth place with 0.5 billion ft^2, deserve special attention for two reasons:

1. MH has the largest surface areas of painted metals among the use-types; and
2. Tax assessor data bases in the SoCAB are the weakest on mobile homes.

TABLE 4-10. ESTIMATED NUMBERS OF NSFR PARCELS WITH BUILDINGS FOR VARIOUS USE-TYPES IN THE SoCAB

County/ Use-Type	All NSFR Parcels	Percent** Parcels w/ Bldg	# Parcels w/ Bldg (A)
Los Angeles			
SMFR	67,954	98.9	67,207
LMFR	61,246	99.0	60,634
RCOND*	162,080	99.5	161,270
MH	55,000	98.6	54,230
SNR	25,559	60.8	15,540
LNR	119,604	91.5	109,438
MJR	22,662	91.5	20,736
UNK	3,027	92.3	2,794
VAC	126,680	47.0	59,540
L.A. Total	643,812	85.6	551,389
Composite			
MFR	34,521	98.3	33,934
RCOND*	100,308	91.5	91,782
MH	29,404	98.6	28,992
NR	73,114	85.5	62,512
AGR	12,880	71.4	9,196
UNK	7,770	51.3	3,986
VAC	205,618	12.8	26,319
COMP Total	463,615	55.4	256,721
SoCAB Total	1,107,427	73.0	808,110

* As listed in assessor records, namely, the number of ownership units.

** Estimates based on results of the parcel file sample.

TABLE 4-11. TOTAL EXPOSED SURFACE AREAS BY MATERIAL FINISH FOR NSFR USE-TYPES IN LOS ANGELES COUNTY (All values in 10^6 ft^2).

	Material-Finish	SMFR 67207*	LMFR 60634	RCOND 161,270	SNR 15540	LNR 109438	MJR 20736	UNK 2794	VAC 59540	MH 54230	Total 551389
111	Block - Bare	14.0	19.0	2.4	4.4	26.2	12.9	0.2	9.9	4.3	93.3
112	Block - Painted	14.6	20.7	2.4	20.5	195.8	36.8	0.2	12.6	4.3	307.9
121	Brick - Bare	0.6	1.0	2.3	0.6	78.9	60.5	-	-	-	143.9
122	Brick - Painted	-	-	-	-	26.9	0.4	-	-	-	27.3
131	Concrete - Bare	59.6	77.8	28.9	18.3	469.4	107.5	22.5	97.6	12.7	894.3
132	Concrete - Painted	-	-	7.9	16.7	88.7	3.1	4.2	1.6	-	122.2
142	Stucco - Painted	301.5	490.5	174.3	9.3	171.0	18.1	-	7.1	4.9	1176.7
151	Tile - Bare	-	-	-	-	-	-	-	-	-	-
161	Terra Cotta - Bare	3.8	9.6	2.6	2.8	9.5	1.5	-	3.1	-	32.9
162	Terra Cotta - Painted	-	-	-	-	1.1	-	-	-	-	1.1
311	Fieldstone - Bare	0.1	-	-	-	-	-	-	-	-	0.1
321	Granite - Bare	-	-	-	-	-	-	0.2	-	-	0.2
351	Volcanic - Bare	-	-	-	-	-	-	-	-	-	-
411	Aluminum - Bare	0.1	-	0.3	0.1	0.3	0.1	-	0.3	-	1.2
412	Aluminum - Painted	1.8	0.3	-	39.4	6.6	0.4	-	2.1	161.0	211.6
441	Steel - Bare	-	0.5	-	0.4	18.5	2.8	-	2.6	-	24.8
442	Steel - Painted	0.8	2.8	0.8	13.7	57.6	16.3	0.2	1.1	-	93.3
451	Galvanized Steel - Bare	1.1	1.4	1.1	0.8	10.8	2.4	0.2	0.5	-	18.3
462	Iron - Painted	0.1	-	-	-	-	-	-	-	-	0.1
471	Chain Link - Bare	4.9	0.5	-	4.3	39.5	6.7	-	13.3	-	69.2
591	Unspecified Metal - Bare	0.3	0.1	-	1.2	32.0	4.6	-	0.8	72.3	111.3
592	Unspecified Metal - Painted	0.3	0.5	-	41.4	9.1	1.3	-	0.5	-	53.1
711	Wood - Bare	24.2	11.0	19.9	3.2	5.6	0.2	-	4.8	-	68.9
712	Wood - Painted	51.8	64.8	10.7	2.8	15.7	1.8	-	-	3.4	151.0
714	Wood - Varnish	-	-	-	-	-	-	-	0.3	-	0.3
715	Wood - Stained	24.2	11.0	19.9	3.1	5.3	0.2	-	-	-	63.7
721	Wood Shingle - Bare	6.8	12.5	-	1.8	0.3	-	-	-	5.1	26.5
722	Wood Shingle - Painted	-	1.8	0.2	0.2	0.7	-	-	-	-	2.9
731	Plastic - Bare	0.2	0.1	0.2	0.5	5.3	1.0	-	2.9	-	10.2
732	Plastic - Painted	-	-	-	-	-	-	-	-	-	-
761	Asphalt - Bare	42.2	86.8	9.8	127.7	953.2	253.2	-	52.1	25.4	1550.4
771	Asphalt Roofing - Bare	314.9	515.2	174.1	95.7	1209.1	312.8	16.6	124.5	150.6	2913.5
781	Glass - Bare	43.1	64.8	24.2	6.8	52.4	5.7	7.1	2.8	10.5	217.4
782	Glass - Painted	-	0.4	-	-	0.3	-	-	-	-	0.7
791	Fiberglass - Bare	0.7	-	-	6.4	-	-	-	3.6	5.4	16.1
	Total Exposed Area	911.8	1393.6	482.1	421.8	3490.6	851.0	51.7	344.5	459.9	8404.4

* The estimated number of NSFR parcels with buildings for the designated use-type in Los Angeles County.

As stated earlier, treatments of mobile homes in assessor records vary considerably from county to county. The estimated numbers of mobile homes in this report were arrived at by different means for the four counties. The estimated material surfaces for MH in Table 4-11 were computed under the assumption that the single MH cluster with 40 mobile homes examined in the building file sample was representative of the mobile home population in Los Angeles County as well as of that in Composite County. Admittedly, this assumption deserves to be examined, requiring an additional study in the future.

The two poorly defined use-types, VAC and UNK, in the assessor data bases rank 8th and 9th with 0.3 and 0.1 billion ft^2, respectively. This is fortunate in that possible mis-estimates in exposed material surfaces for these use-types would not affect much the overall estimates of material surfaces based on the assessor data bases.

Table 4-12 shows total exposed surface areas by material-finish for seven NSFR use-types in Composite County: MFR, RCOND, NR, AGR, MH, UNK and VAC. The three well-defined use-types, NR, RCOND and MFR take the first three places with 2.4, 1.6 and 0.8 billion ft^2 of exposed material surfaces, respectively. VAC is in the fourth place with 0.7 billion ft^2 while MH is in the fifth place with a quarter billion ft^2. The last two places are taken by AGR and UNK with 0.2 billion ft^2 each.

The total exposed material surfaces of NSFRs are estimated to be 8.4 billion ft^2 for Los Angeles County and 6.1 billion ft^2 for Composite County. These NSFR values are nearly comparable with SFR counterparts: 12.7 billion ft^2 for Los Angeles and 7.8 billion ft^2 for Composite County (see Table 3-19). Although NSFRs account for only about a third of the total number of parcels in the SoCAB, their material surfaces account for over 40 percent of the overall material surfaces of SFRs and MSFRs. This is reasonable because NSFRs tend to have larger material surfaces per parcel than SFRs.

TABLE 4-12. TOTAL EXPOSED SURFACE AREAS BY MATERIAL-FINISH FOR SEVEN NSFR USE-TYPES IN COMPOSITE COUNTY (All values in 10^6 ft^2).

	Material-Finish	MFR 33934*	RCOND 91782	NR 62512	UNK 3986	VAC 26319	AGR 9196	MH 28992	Total 256721
111	Block - Bare	4.2	13.1	29.4	1.7	6.1	16.1	2.3	72.9
112	Block - Painted	7.7	13.0	102.7	1.7	12.0	16.0	2.3	155.4
121	Brick - Bare	0.3	2.1	3.3	3.7	0.1	0.4	-	9,9
122	Brick - Painted	-	-	4.3	-	-	-	-	4.3
131	Concrete - Bare	43.5	192.6	145.8	48.5	33.1	-	6.8	470.3
132	Concrete - Painted	-	-	108.6	-	17.4	-	-	126.0
142	Stucco - Painted	297.1	337.8	109.1	3.3	40.7	55.4	2.6	846.0
151	Tile - Bare	-	-	-	-	-	-	-	-
161	Terra Cotta - Bare	3.5	-	28.2	-	4.6	-	-	36.3
162	Terra Cotta - Painted	-	-	-	-	-	-	-	-
311	Fieldstone - Bare	0.3	-	0.2	-	-	-	-	0.5
321	Granite - Bare	-	-	-	-	-	-	-	-
351	Volcanic - Bare	-	-	-	-	-	-	-	-
411	Aluminum - Bare	-	-	0.2	-	0.1	-	-	0.3
412	Aluminum - Painted	-	-	0.5	-	-	-	86.1	91.1
441	Steel - Bare	-	-	15.7	-	6.9	5.9	-	28.5
442	Steel - Painted	0.3	3.0	39.8	-	11.3	-	-	54.4
451	Galvanized Steel - Bare	0.3	3.4	6.6	-	1.8	0.2	-	12.3
462	Iron - Painted	0.2	-	-	-	-	-	-	0.2
471	Chain Link - Bare	0.6	-	26.8	6.5	0.2	-	-	34.1
591	Unspecified Metal - Bare	0.3	-	13.0	2.4	17.3	2.8	38.7	74.5
592	Unspecified Metal - Painted	-	-	38.7	-	-	-	-	38.7
711	Wood - Bare	14.4	9.0	5.9	-	2.9	-	-	32.2
712	Wood - Painted	22.6	190.2	19.0	7.0	6.4	6.7	1.8	253.7
714	Wood - Varnish	-	-	-	-	-	-	-	-
715	Wood - Stained	14.4	9.0	5.9	-	2.9	-	-	32.2
721	Wood Shingle - Bare	15.5	265.2	5.0	19.1	-	-	2.7	307.5
722	Wood Shingle - Painted	0.8	-	0.7	-	-	-	-	1.5
731	Plastic - Bare	-	-	4.3	-	0.7	-	-	5.0
732	Plastic - Painted	-	-	0.2	-	0.2	-	-	0.4
761	Asphalt - Bare	90.6	240.1	945.0	61.6	342.0	-	13.6	1692.9
771	Asphalt Roofing - Bare	297.8	239.0	658.6	5.1	146.9	80.0	80.5	1507.9
781	Glass - Bare	35.3	82.2	49.1	4.7	25.2	7.1	5.6	209.2
782	Glass - Painted	-	-	-	-	0.6	-	-	0.6
791	Fiberglass - Bare	-	-	-	-	-	-	2.9	2.9
	Total Area	849.6	1599.7	2371.5	165.2	679.3	190.6	246.0	6101.9

* The estimated number of NSFR parcels with buildings for the designated use-type in Composite County.

As in the case of SFRs, certain items in NSFRs were simply enumerated by categorization. These items are: light poles, satellite dishes, sheds, signal billboards, solar panels, TV antenna and tanks. The incidence rates of these items in NSFR parcels are summarized in Table 4-13. The most common enumeration item was light poles, followed by TV antennas, solar panels and signs. Metal sheds and fuel tanks were also spotted. The least common item was satellite dishes which were spotted less frequently than one out of 100 cases.

TABLE 4-13. MATERIAL-FINISH SURFACE AREAS FOR ENUMERATION ITEMS ASSOCIATED WITH NSFRs. (Value in # items/parcel or ft^2/parcel)

Enumeration Items/ Material-Finish	Los Angeles 1050	Composite 418*	SoCAB 1468*
# Enumeration Items			
Light Poles	.23	.35	.27
Satellite Dishes	-	-	-
Sheds	.06	.11	.08
Signs/Billboards	.06	.22	.12
Solar Panels	.17	.12	.15
Solar Panels	.17	.12	.15
TV Antennas	.22	.07	.15
Tanks	.06	-	.03
Material-Finish			
Galvanized Steel - Bare	13.2	18.8	15.0
Steel - Painted	5.8	4.7	5.3
Aluminum - Bare	2.2	2.4	2.2
Aluminum - Painted	0.1	0.3	0.2
Unspecified Metal - Bare	11.6	42.7	23.3
Unspecified metal - Painted	25.1	31.7	25.7
Copper - Bare	0.6	0.4	0.5
Wood - Painted	0.7	1.2	0.9
Plastic - Bare	4.1	2.9	3.6
Glass - Bare	0.2	0.3	0.2

* The number of parcels in the building file sample. Those for Composite County and the SoCAB are corrected for the anomaly in MH parcels as discussed in the text.

Material-finish surface areas of these identified enumeration items were also presented in this table. These areas were computed by multiplying the above incidence rates with the material factors of the enumeration items, which are listed in Appendix G. The most abundant material associated with these enumeration items is, by far, metals: unspecified metal with 49 ft^2/parcel, steel with 18 ft^2/parcel, aluminum with 2.4 ft^2/parcel, and copper with 0.5 ft^2/parcel. Other materials are plastic (3.6), wood (0.9) and glass (0.2).

Table 4-14 shows total exposed material surfaces of the NSFR enumeration items in the SoCAB. The total exposed area of 62 million ft^2 for these items is minuscule as compared to 14.5 billion ft^2 of NSFR exterior surfaces. However their contribution to basinwide totals of unspecified metals, galvanized steel and plastic appear to be rather significant. Copper was found only in these enumeration items.

TABLE 4-14. TOTAL EXPOSED MATERIAL SURFACES ASSOCIATED WITH NSFR ENUMERATION ITEMS IN THE SoCAB (All values in 10^6 ft^2)

Material-Finish	Los Angeles 551389*	Composite 256721	SoCAB 808110
Galvanized Steel - Bare	7.3	4.8	12.1
Steel - Painted	3.2	1.2	4.4
Aluminum - Bare	1.2	0.6	1.8
Aluminum - Painted	-	0.1	0.1
Unspecified metal - Bare	6.4	10.9	17.3
Unspecified metal - painted	13.9	8.1	22.0
Cooper - Bare	0.3	0.1	0.4
Wood - Painted	0.3	0.4	0.7
Plastic - Bare	2.2	0.7	2.9
Glass - Bare	0.1	0.1	0.2
Total	34.9	27.0	61.9

* The estimated number of NSFR parcels with buildings in designated region.

5.0 INFRASTRUCTURES

5.1 GENERAL

In addition to materials associated with SFRs and NSFRs, there appear to be considerable amounts of materials elsewhere, particularly with infrastructures such as highways, surface streets, railroads, channelized waterways, and power transmission and distribution systems. In the previous ARB study (Murray et al 1985), exposed surfaces of these materials were estimated based only on available statistics from CALTRANS and cities.

To develop an inventory of materials-in-place in these infrastructures, three types of data are needed:

1. Accurate statistics on the infrastructure facilities (e.g., highways and surface streets);
2. Accurate enumeration of all material-bearing items associated with the infrastructure; and
3. Accurate material factors showing what materials and what quantities of those materials compose the items.

As to the first two data types, there is some hope that sources can be found. However, it is very unlikely that the necessary material factors have ever been determined for most materials which compose the surfaces of their numerous types of material-bearing items. Therefore, for every infrastructure type, VRC attempted to develop accurate material factors for the most relevant material-bearing items.

As to the first two data types the data gathering task was to fill the gaps in the existing data and statistics. Detailed discussions on these data gathering tasks are given in sections that follow.

5.2 MATERIALS IN HIGHWAYS

Reliable statistics on transportation facilities are available from the California Department of Transportation (CALTRANS) Highway Performance and Monitoring System (HPMS). Using the HPMS data summary (CALTRANS 1984), road miles in the SoCAB were estimated (See Table 5-1) for all twelve functional classes of roads, ranging from interstate highways to local streets for urban

and rural areas. Through careful examination of CALTRANS' road maps for four counties, the SoCAB share of county total road miles in each county was estimated separately for "rural" and "urban" roads. For instance, only 10 percent of total rural roads in Los Angeles County appear to belong to the SoCAB whereas practically all urban roads of that county are in the SoCAB. By applying these estimated SoCAB fractions to the reported road miles for "rural" and "urban" roads in each of the four counties, total road miles in the SoCAB were calculated in Table 5-1.

TABLE 5-1. ROAD MILES BY FUNCTIONAL CLASS IN THE SoCAB (after CALTRANS 1984).

Functional Class	Counties of Los Angeles	Orange	Riverside	San Brndn	Four Counties	SoCAB*
Rural						
Interstate	41	4	174	319	538	127
Principal Arterial	49	7	56	110	222	51
Minor Arterial	177	23	300	514	1,014	242
Major Collector	547	70	692	1,182	2,491	589
Minor Collector	841	2	606	368	1,817	426
Local	2,246	231	2,312	2,986	7,775	1,910
Rural Total	3,901	337	4,140	5,480	13,858	3,345
Urban						
Interstate	237	66	22	61	386	378
Other Fwy & EXPRWY	193	63	52	35	343	334
Principal Arterial	2,211	574	143	311	3,244	3,199
Minor Arterial	1,929	606	297	563	3,395	3,309
Collector	2,015	347	309	455	3,126	3,050
Local	10,516	3,274	1,603	2,205	17,598	17,217
Urban Total	17,101	4,935	2,425	3,630	28,091	27,486
Grand Total	21,002	5,272	6,565	9,110	41,949	30,831

* SoCAB Rural = 0.1 LA + 1.0 OR + 0.5 RS + 0.1 SB
SoCAB Urban = 1.0 LA + 1.0 OR + 0.9 RS + 0.9 SB

Table 5-2 presents VRC estimates of road miles in SoCAB and the component counties according to a classification previously used in ARB's Heavy Duty Truck Study (Horie and Rapoport 1985). State highways include almost all roads of the following classes: Interstate, Principal Arterial and Minor Arterial in rural areas; and Interstate and Other Freeway/Expressway in urban areas. Therefore, these classes of roads are grouped into State Highway in Table 5-2. The remainder of road types listed in this table were included in a special street survey which was conducted under this study (see Section 5.2.2).

TABLE 5-2. TOTAL ROAD MILES BY TYPE AND COUNTY SHARE OF SoCAB TOTAL

Road Type	SoCAB Portion of				SoCAB
	Los Angeles	Orange	Riverside	San Bernardn	Total
State Highway	457	163	332	180	1,132
	(41)	(14)	(29)	(16)	(100)
Principal Arterial	2,211	579	129	280	3,199
	(69)	(18)	(4)	(9)	(100)
Minor Arterial	1,929	606	267	507	3,309
	(58)	(18)	(8)	(16)	(100)
Urban Collector	2,015	347	278	410	3,050
	(66)	(11)	(9)	(14)	(100)
Urban Local	10,516	3,274	1,443	1,984	17,217
	(61)	(19)	(8)	(12)	(100)
Rural Collector*	139	72	649	155	1,015
	(14)	(7)	(64)	(15)	(100)

( ) = Percent of SoCAB Total

* Rural Collector includes both Major and Minor Rural Collectors as defined by CALTRANS

5.2.1 ITEMS ASSOCIATED WITH STATE HIGHWAYS

As to material-bearing items associated with state highways in Los Angeles and Orange counties, the CALATRANS local district office in Los Angeles provided us with the latest counts of those items. In these counties, the state highways were principal interstate highways, freeways and state-numbered highways including some primary arterials. The total length of these roads was estimated to be 860 miles over the two counties.

CALTRANS provided enumeration statistics on street lights, one-post signs (on freeways), two-post signs (on freeways), signs attached to bridges, shoulder reflectors, guardrails and chain link fence. These statistics are listed in Table 5-3, together with some other items which VRC enumerated using the Thomas Bros. Maps of the four-county area. Since the CALTRANS statistics were for Los Angeles and Orange Counties, their values were scaled up to the SoCAB using a ratio of cumulative road miles for the two counties and the SoCAB.

Among the enumeration items, shoulder reflectors are the most numerous with 137,000, whereas the freeway interchanges are the least numerous with 65. Among the three mileage items, chain link fence is the most abundant with 2,600 linear miles.

5.2.2 ITEMS ASSOCIATED WITH SURFACE STREETS

For roads other than State Highways, VRC found no organization which could provide reliable statistics of material-bearing items associated with surface streets. Therefore, a special street survey was designed and implemented to gather data on such items. The road types included in the street survey were:

Urban Area

- Principal Arterial (PA)
- Minor Arterial (MA)
- Collector (COL)
- Local(LOC)

Rural Area

- Major Collector (MJC)

TABLE 5-3. NUMBERS OF ENUMERATION ITEMS ASSOCIATED WITH STATE HIGHWAYS IN SoCAB

Enumeration Item	Counts or miles	Road Miles Surveyed*	SoCAB Road Miles	SoCAB Total
Street Light - B. Steel	19,625	860	1,132	25,832
One Post Sign	2,436	860	1,132	3,207
Two Post Sign	722	860	1,132	950
Sign Attached to Bridge	588	860	1,132	774
Shoulder Reflector	104,000	860	1,132	136,895
On/Off Ramps	4,228	1,132	1,132	4,228
Fwy Interchange - T	16	1,132	1,132	16
Fwy Interchange - Y	15	1,132	1,132	15
Fwy Interchange - X	34	1,132	1,132	34
Over/Under Pass	1,455	1,132	1,132	1,455
Guardrail - Metal	420mi	860	1,132	553mi
Guardrail - Concrete	500mi	860	1,132	658mi
Chain Link Fence	1,975mi	860	1,132	2,600mi

* Items indicated by "860" were obtained from CALTRANS District 7 while those indicated by "1,132" miles were determined using Thomas Bros. Map.

Road miles of these road types are summarized in Table 5-2. The numbers of survey routes selected for each of the five road types are given in Table 5-4. (Figure 5-1 shows locations of these survey routes.) These routes were selected by consulting CALTRANS functional class street maps for the SoCAB. The survey did not deal with either rural local roads or rural minor collectors. The reason for the former was that no significant amounts of street signs and

other items were not expected to be found on rural local roads. The reason for the latter was that data obtained from the survey of major collectors would be used to approximate the levels of item number densities for minor collectors.

The numbers of selected routes (Table 5-4) varied greatly, from 1 for major collector to 30 for urban local whereas length of survey routes was maintained around 50 miles for all road types. The reason for the large variation in the number of routes among the road types is rooted in the CALTRANS functional classification itself. The functional class of a particular street is determined by the balance of mobility and accessibility of the street. Local streets have greater accessibility relative to mobility whereas arterial streets have greater mobility relative to accessibility. Local streets feed into collector streets, which in turn feed into arterial streets. As a result, local streets are numerous but usually short. Arterial streets, on the other hand, are less numerous but, on the whole, longer.

TABLE 5-4. SUMMARY OF ROUTES SELECTED FOR THE SPECIAL STREET SURVEY

Road Type	Number of Survey Routes					# Miles
	Los Angeles	Orange	Riverside	San Brndn	SoCAB	Surveyed
Urban Area						
Principal Arterial	2	1			3	59.9
Minor Arterial	1	1		1	3	41.0
Collector	7	1	1	1	10	51.9
Local	10	9	5	6	30	64.9
Rural Area						
Major Collector			1		1	64.0
All Road Types	20	12	7	8	47	281.7

Average lengths of the selected routes were: 20 miles for PA, 15 miles for MA, 5 miles for COL and 2 miles for LOC in urban area; and 64 miles for MJC in rural area. The long, single route for MJC was caused by the scarcity of

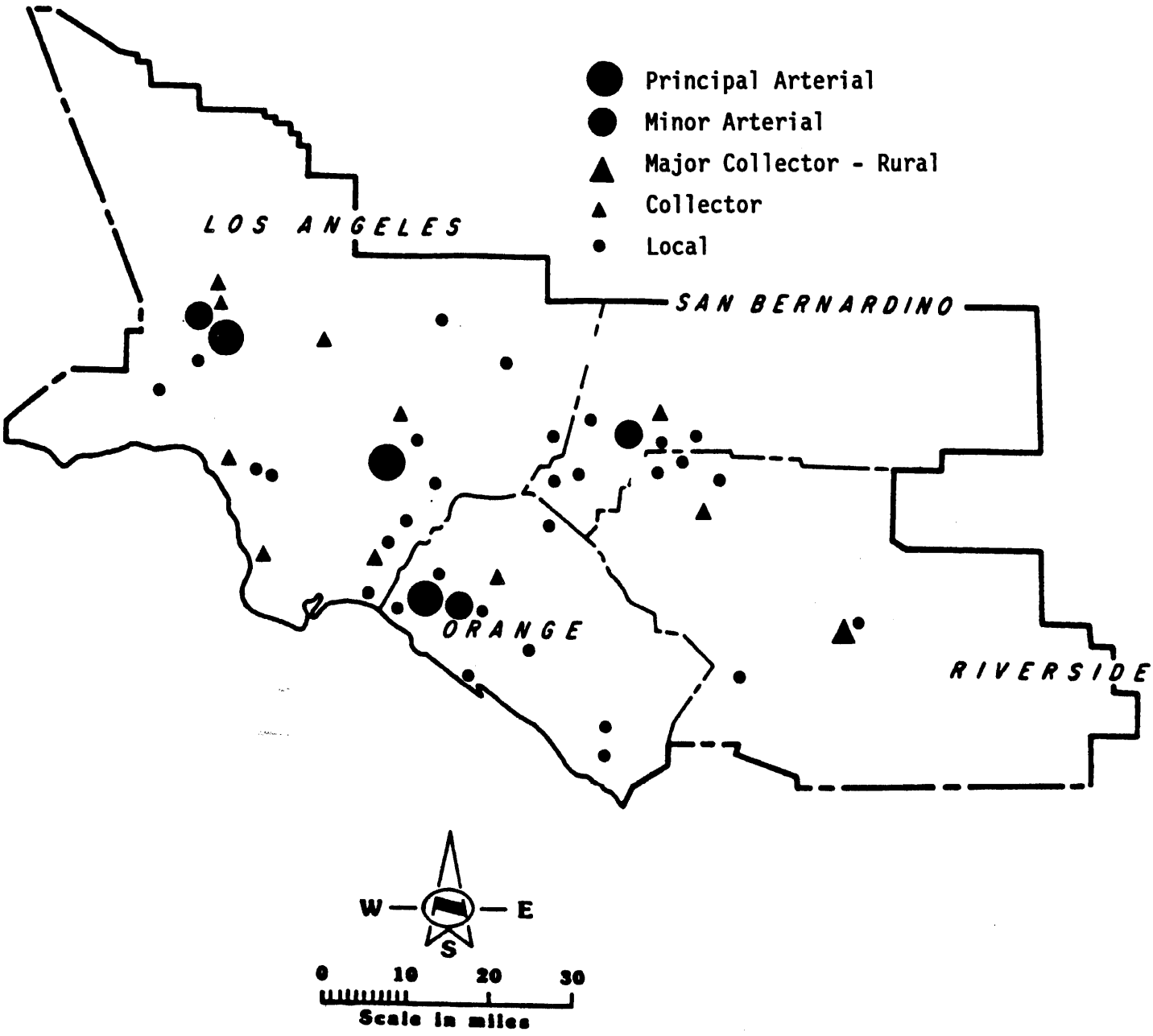

Figure 5-1. Locations of Special Street Survey Sites
(3 PA, 3 MA, 1 MJC, 10 COL and 30 LOC)

major collector streets in the SoCAB, except in Riverside County where the route was located.

Prior to the actual street survey, nearby streets were surveyed to learn what types of items occur along urban roads. Based on this experience, a street survey form, shown in Appendix I, was developed and used in the actual survey. The items included in the survey form are:

Street Light	steel, concrete, arm only
Signal Light	overhang, upright
Sign Post	metal pole, grated metal, wooden post
Other	hydrant, mailbox, shoulder reflector, railroad crossing
Miles	curb, sidewalk, metal guardrail, concrete guardrail

Road surface materials were not included because of heavy wear due to traffic.

The street survey was conducted during the period of the SFR field survey by the same surveyors. Each route was surveyed while the team of two surveyors drove the survey route either in one direction only or in both directions. In the usual division of labor, the driver spots an item or items, and tells his partner the number and type of the item while driving. Then, the partner records a mark or landmarks at the appropriate space in the survey form.

Table 5-5 shows summary results of the street survey. Both the numbers and types of material-bearing items found on the four types of urban routes are far greater than those on the rural route of MJC. For example, the numbers of street lights on the urban routes range from 1600 for LOC to 2900 for PA whereas that of MJC is 12. Similar relations are found in street lights, metal posts and other items such as hydrants, mail boxes, shoulder reflectors and railroad crossings.

Based on this finding, the exclusion of rural local roads from this street survey seem to be justified. Further, to compensate for the loss of items that may be associated with rural local roads, the item number density in minor collectors is assumed to be the same as that in major collectors.

In Table 5-6, the survey results in Table 5-5 are extrapolated to the entire SoCAB, based on ratios of the basinwide road miles to the surveyed road miles in each road type. The estimated numbers of enumeration items in the SoCAB range from 730,000 light poles and 613,000 metal posts to 135,000 hydrants. Basinwide linear miles of curbs and sidewalks are estimated to be 48,000 and 37,000, respectively.

TABLE 5-5. SUMMARY RESULTS OF THE STREET SURVEY

Item	Street Survey PA 59.9*	MA 41.0	COL 51.9	LOC 64.9	MJC 64.0
Street Light - B. Steel	472	316	44	10	4
Street Light - Pt. Steel	170	134	264	130	-
Street Light - Concrete	1076	244	444	1046	2
Street Light - Arm Only	686	382	228	430	6
Stop Light - B. Overhang	432	160	30	14	6
Stop Light - Pt. Overhang	10	12	2	-	-
Stop Light - B. Upright	204	44	86	24	4
Stop Light - Pt. Upright	42	22	30	-	-
Solid Metal Post - B.	656	448	562	836	102
Solid Metal Post- Pt.	18	2	186	18	16
Grated Metal Post -	1116	672	766	384	4
Grated Metal Post - Pt.	4	24	90	-	-
Wooden Post - B.	226	72	94	116	240
Wooden Post - Pt.	346	22	346	158	58
Hydrant - Pt.	730	352	374	166	78
Mail Box - Pt.	88	6	52	12	6
Shoulder reflector	84	48	-	10	-
Rail Road Crossing	18	6	-	-	8
Curb*	118.2	54.0	99.2	117.0	1.2
Sidewalk*	113.0	40.4	83.2	85.4	-
Guardrail* - Metal	2.8	1.2	0.2	-	-
Guardrail* - Concrete	0.6	0.8	-	-	-

* In miles

TABLE 5-6. NUMBER OF ENUMERATION ITEMS BY ROAD TYPE IN SoCAB

Enumeration Item	Principal Arterial	Minor Arterial	Urban Collector	Urban Local	Rural Collector	Total Surface St.
Street Light - B. Steel	51,910	25,504	2,586	2,652	64	82,716
Street Light - Pt. Steel	9,078	10,814	15,514	34,488	0	69,894
Street Light - Concrete	57,464	23,728	26,092	277,488	32	384,805
Street Light - Arm Only	36,636	30,830	13,398	114,072	96	195,032
Stop Light - B. Overhng	23,072	12,914	1,764	3,714	96	41,560
Stop Light - Pt. Overhng	534	1,168	118	0	0	1,820
Stop Light - B. Upright	10,894	7,586	5,054	6,366	64	29,964
Stop Light - Pt. Upright	2,244	1,776	1,764	0	0	5,784
Solid Metal Post -B.	35,034	36,156	33,026	221,778	1,618	327,612
Solid Metal Post -Pt.	962	162	11,130	4776	254	17,284
Grated Metal Post - B.	59,600	54,236	45,016	101,870	64	260,786
Grated Metal Post - Pt.	214	1,936	5,290	0	0	7,440
Wooden Post - B.	12,070	5,810	5,524	30,774	3,806	57,984
Wooden Post - Pt.	18,478	1,776	20,334	41,916	920	83,424
Hydrant - Pt.	38,986	28,408	21,978	44,038	1,238	134,648
Mail Box - Pt.	4,700	484	3,056	3,184	96	11,084
Shoulder Reflector	4,486	3,874	0	2652	0	11,012
Rail Road Crossing	962	484	0	0	126	1,572
Curb	6,312	4,358	5,830	31,038	19	47,557mi
Sidewalk	6,034	3,260	4,890	22,656	0	36,840mi
Guardrail - Metal	150	96	12	0	0	258mi
Guardrail - Concrete	32	64	0	0	0	96mi

5.2.3 BASINWIDE INVENTORY OF MATERIALS IN HIGHWAYS

For all material-bearing items accounted for in state highways and surface streets, we selected a few typical samples of each item and made on-site measurements of their exterior surfaces. In complexity, these items ranged from the simple geometry of sidewalks to the complex surface geometry of freeway signs. Even for sidewalks, their width varied somewhat from one survey site to another. After we took measurements on a few sidewalks with different widths, we estimated and average width for sidewalks. Although the measurements and calculations were more involved, a similar procedure was used to determine average dimensions and representative material-finish mixes of other enumeration items. In many cases, detailed engineering calculations were required to reduce on-site measurement data of an item into a final material factor for that item. The material factors so determined are all listed in Appendix G.

By combining the material factors and the enumeration counts of items on state highways and surface streets, a basinwide inventory of materials-in-place in the highway infrastructure was developed. Table 5-7 shows a summary of such inventory whereas more detailed inventory values are listed in Appendix J.

TABLE 5-7. TOTAL EXPOSED MATERIAL SURFACES OF ITEMS ASSOCIATED WITH HIGHWAYS IN THE SoCAB (All values in 10^6 ft^2)

Material Fence	State Highway 1132 mi	Surface Streets 27790* mi	Total 28922* mi
Chain Link Fence	82.4	0.0	82.4
Concrete - Bare	65.7	1326.8	1392.5
Aluminum - Bare	0.2	4.6	4.8
Galv. Steel - Bare	4.4	16.6	21.0
Galv. Steel - Painted	-	0.3	0.3
Steel - Bare	-	-	-
Steel - Painted	0.1	9.7	9.8
Unspecified metal - Bare	74.8	3.7	78.5
Unspecified Metal - Painted	1.0	10.1	11.1
Wood - Bare	3.6	2.2	5.8
Wood - Painted	-	0.8	0.8
Glass - Bare	-	0.8	0.8
Plastic - Bare	-	1.8	1.8
Total	232.2	1377.4	1609.6

* Excluding rural local road miles.

As anticipated, bare concrete is the dominant material-finishes, with 1.4 billion square feet. All other material-finishes are two orders of magnitude smaller than these. Relatively abundant materials are: chain link fence with 82 million ft^2, bare metal with 79 million ft^2, galvanized steel with 21 million ft^2, painted metal with 10 million ft^2, and painted steel with 10 million ft^2. Although road miles of state highways are only 4 percent of the total road miles in the SoCAB, state highways account for nearly 15 percent of the total material surfaces associated with highways and street.

5.3 MATERIALS IN OTHER INFRASTRUCTURES

In addition to highways, railroads, channelized waterways and power distribution networks were also included in this infrastructure study. For railroads and channelized waterways, our efforts were focussed on quantifying the material density per linear foot of such infrastructure facility and the total miles of the infrastructure facilities in the SoCAB.

For power distribution networks, VRC identified the following as major material-bearing items:

- Transmission tower
- Transmission pole
- Distribution pole
- Substation

Transmission poles differ from distribution poles in that transmission poles are designed to carry high voltage lines and are often erected in pairs.

The latest counts of these material-bearing items were obtained from Southern California Edison Company for their service network in the SoCAB. Table 5-8 presents SCE's counts and VRC estimates for the SoCAB.

TABLE 5-8. ENUMERATION ITEMS OF POWER TRANSMISSION NETWORK IN SoCAB

Item	Counts	Survey Coverage*	SoCAB Total
Distribution Pole	1,000,700	72%	1,389,861
Transmission Pole	120,000	72%	166,667
Transmission Tower	20,000	72%	27,778
Substation	600	72%	833

* Namely, the SCE's share of SoCAB total electricity supply.

It is interesting to note that the numbers of items differ by orders of magnitude: 1.4 million distribution poles, 167,000 transmission poles, 28,000 transmission towers, and 833 substations. However, the material density per item would probably exhibit the reverse order for the four item types. Indeed, the material factors derived from a few on-site measurements of these items indicate the following:

Item	Galvanized Steel (ft^2)
Distribution Pole	5
Transmission Pole	17
Transmission Tower	2240
Substation	11200

Details of these material factors are given in Appendix G.

Total miles of railroads and channelized waterways in the SoCAB were calculated by reading USGS topographic maps and Thomas Bros. Maps. Table 5-9 presents these total miles by county as well as by type of infrastructure. Channelized waterways are disaggregated into creek/wash and river to indicate substantial differences in width and cross section between them (see Appendix G). In railroad miles, Los Angeles County accounts for only 42 percent of the SoCAB total whereas in creek/wash and river miles it accounts for 63 percent and 73 percent, respectively.

TABLE 5-9. TOTAL MILES OF RAILROAD AND CHANNELIZED WATERWAY IN SoCAB

Type of Infra-Structure	SoCAB Portion of Los Angeles	Orange	Riverside	San Bernardino	SoCAB Total
Railroad	228	94	74	148	544
	(42)	(17)	(14)	(27)	(100)
Creek/Wash	233	64	26	46	369
	(63)	(17)	(7)	(13)	(100)
River	84	23	0	8	115
	(73)	(20)	(0)	(7)	(100)

( ) = Percent of SoCAB Total

The high percentages in Los Angeles County for channelized waterways are reasonable because practically all rivers and creeks in Los Angeles and Orange counties are channelized whereas in the other counties only portions of them are channelized.

Basinwide material-finish surfaces of the items associated with infrastructures of power transmission/distribution, railroad and channelized waterway are summarized in Table 5-10. Major materials associated with these infrastructures are: chainlink fence, concrete, steel and wood. The magnitudes of these material surfaces are comparable with those of highways in galvanized steel and steel, but they are an order of magnitude smaller in chain link fence and concrete. There is a large quantity of bare wood, primarily in power distribution/transmission poles.

TABLE 5-10. TOTAL EXPOSED MATERIAL SURFACES OF ITEMS ASSOCIATED WITH OTHER INFRASTRUCTURES (All values in 10^6 ft^2)

Material-Finish	Power Distribution*	Railroad**	Channelized Waterway	Total
Chain Link Fence	-	-	47.8	47.8
Concrete - Bare	-	-	158.1	158.1
Aluminum - Bare	-	-	-	-
Galv. Steel - Bare	81.2	-	-	81.2
Galv. Steel - Painted	-	-	-	-
Steel - Bare	-	11.5	-	11.5
Steel - Painted	20.8	-	-	20.8
Unspecified Metal - Bare	-	-	-	-
Unspecified Metal - Painted	-	-	-	-
Wood - Bare	294.7	-	-	294.7
Wood - Painted	-	-	-	-
Glass - Bare	-	-	-	-
Plastic - Bare	-	-	-	-
Total	396.7	11.5	205.9	614.1

* Power pole wood is reported as bare wood.

** Wood used for railroad bed is not included.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Two previously untried approaches, using tax assessor records as a sampling frame and aerial photographs as a measurement technique have been applied to and proven to be effective for developing inventories of materials-in-place associated with residential and non-residential buildings and within their property boundaries. Despite their complexity, volumenousness and some anomalies, the tax assessor records for land parcels in the four counties composing the SoCAB provided a reliable data base from which representative samples of SFR and NSFR parcels were chosen. In addition, when combined with survey results, this data base provided a firm foundation for estimating the numbers and types of SFR and NSFR parcels with buildings.

A telephone questionnaire survey on a representative sample of 1200 randomly selected SFRs with listed telephone numbers yielded useful data for characterizing buildings in SFR parcels. In addition, the questionnaire survey enhanced the success of the subsequently performed field survey by providing a list of candidate houses and establishing rapport between the house residents and the field surveyors during the survey mission.

In advance of the actual field survey of 200 randomly selected houses from those having completed the questionnaire survey, a cogent measurement protocol was developed, specifying dimensions to be measured, codes to be used to indicate particular types, and items to be enumerated. This protocol helped to make on-site measurements efficient, accurate and consistent. All items enumerated were categorized by type and size. For all enumeration categories, representative material factors were developed based on detailed measurements of typical cases. This approach was used not only for enumeration items found in SFRs but also those in NSFRs and infrastructures such as highways, railroads, channelized waterways and power transmission/distribution networks.

The airphoto analysis method developed in military applications was successfully adapted to surveying NSFR parcels. During the aerial photography mission, a comprehensive, systematic series of photographs of each of the 30 study sites was taken using the Enviro-Pod camera system mounted on a light aircraft. The low altitude, oblique, high quality photographs of NSFR-rich areas were examined by the airphoto-interpreter, in connection with tax assessor records and cadastral maps of study parcels, to identify, measure and inventory all building surface materials in those parcels. This airphoto method proved to be effective and reliable in obtaining factual data on material-finishes of all exterior surfaces as well as on types and dimensions of lbuildings in each study parcel.

The street survey conducted in this study provided previously unavailable data about the types and quantities of material-bearing items associated with surface streets. Merged with the available statistics of material-bearing items in state highways, this newly acquired data enabled us to develop a comprehensive, reliable inventory of materials-in-place in highway infrastructures. Additional survey efforts on railroads, channelized waterways and power transmission/distribution networks generated an overall inventory of materials-in-place in infrastructures, which none of the earlier studies had accomplished.

In conclusion, this comprehensive inventory was made possible only by the multi-faceted approach developed and applied under this study. The core elements of this approach were:

- Use of land parcel as a basic sampling unit;
- Use of tax assessor data bases as sampling frames of SFRs and NSFRs;
- Use of a clearly defined measurement system in conducting field surveys;
- Use of low altitude, oblique aerial photographs in conuunction with assessor records and cadastral maps in surveying NSFR parcels; and
- Design and implementation of an overall survey plan.

Table 6-1 presents a summary of the inventory for all six facility populations surveyed under this study: SFRs, NSFRS, SFR enumeration items, NSFR enumeration items, highways, and other infrastructures. As correctly perceived in this study, NSFRs turn out to be as important as SFRs in materials inventory by contributing nearly 40 percent of the basin total material surfaces. None of the earlier studies incorporated a significant effort on NSFRs as this study has done.

TABLE 6-1. SUMMARY OF MATERIAL-FINISH INVENTORY IN THE SoCAB (All values in 10^6 ft^2)

Material-Finish		Enumeration SFR	NSFR	SFR	NSFR	HWY	OI	Ground Total
111	Block - Bare	1237	166	-	-	-	-	1403
112	Block - Painted	47	463	-	-	-	-	510
121	Brick - Bare	529	154	-	-	-	-	683
122	Brick - Painted	37	32	-	-	-	-	69
131	Concrete - Bare	2233	1365	-	-	1393	158	5149
132	Concrete - Painted	133	248	-	-	-	-	381
141	Stucco - Bare	679	-	-	-	-	-	679
142	Stucco - Painted	3036	2023	-	-	-	-	5059
151	Tile - Bare	7	-	-	-	-	-	7
152	Tile - Painted	2	-	-	-	-	-	2
161	Terra Cotta - Bare	400	69	-	-	-	-	469
162	Terra Cotta - Painted	-	1	-	-	-	-	1
181	Cement Shingle - Bare	164	-	-	-	-	-	164
311	Fieldstone - Bare	-	1	-	-	-	-	1
321	Granite - Bare	-	-	-	-	-	-	-
351	Volcanic - Bare	-	-	-	-	-	-	-
391	Unspecified Stone - Bare	71	-	-	-	-	-	71
411	Aluminum - Bare	170	2	-	2	5	-	179
412	Aluminum - Painted	319	303	3	-	-	-	625
421	Anodized Aluminum - Bare	9	-	5	-	-	-	14
431	Aluminum Screen - Bare	74	-	-	-	-	-	74
441	Steel - Bare	9	53	-	-	-	12	74
442	Steel - Painted	26	148	67	4	10	21	276
451	Galvanized Steel - Bare	63	31	9	12	21	81	217
452	Galvanized Steel - Painted	50	-	-	-	-	-	50
461	Iron - Bare	-	-	-	-	-	-	-
462	Iron - Painted	43	-	-	-	-	-	43
471	Chain Link - Bare	653	103	-	-	82	48	886
491	Copper - Bare	-	-	3	1	-	-	4
501	Chicken Wire - Bare	50	-	-	-	-	-	50
611	Nylon - Bare	1	-	-	-	-	-	1
591	Unspecified Metal - Bare	7	186	-	17	79	-	289
592	Unspecified Metal - Painted	9	92	-	22	11	-	134
711	Wood - Bare	948	101	-	-	6	295	1350
712	Wood - Painted	3354	405	-	1	1	-	3761
714	Wood - Varnish	-	-	-	-	-	-	-
715	Wood - Stained	140	96	-	-	-	-	236
721	Wood Shingle - Bare	1457	334	-	-	-	-	1881
722	Wood Shingle - Painted	28	4	-	-	-	-	32
725	Wood Shingle - Stained	3	-	-	-	-	-	3
731	Plastic - Bare	3	15	11	3	2	-	34
732	Plastic - Painted	-	-	-	-	-	-	-
741	Vinyl (hard) - Bare	4	-	-	-	-	-	4
742	Vinyl (hard) - Painted	-	-	-	-	-	-	-
751	Tar - Bare	617	-	-	-	-	-	617
761	Asphalt - Bare	357	3243	-	-	-	-	3600
771	Asphalt Roofing - Bare	2703	4421	-	-	-	-	7124
781	Glass - Bare	515	427	4	-	1	-	947
782	Glass - Painted	-	1	-	-	-	-	1
791	Fiberglass - Bare	60	19	-	-	-	-	79
801	Fiberglass Screen - Bare	196	-	-	-	-	-	196
811	I/O Carpet - Bare	24	-	-	-	-	-	24
	Total Area	20474	14506	102	62	1610	614	37368

The enumeration items in SFRs and NSFRs are found to be important contributors for certain materials, such as painted and bare metals, although their contributions to overall total material surfaces are rather minimal. The same is true for highways and other infrastructures. These infrastructures contribute very significantly to concrete. They also contribute significantly to bare and painted metals, chain link fence and bare wood.

6.2 RELIABILITY OF ESTIMATES

In this study, a comprehensive inventory of materials-in-place was compiled by estimating exposed surface areas of numerous materials found in buildings and other structures in SFRs, NSFRs and infrastructures. These estimates were derived from the population statistics of material bearing facilities and results of the SFR, NSFR and Infrastructure surveys conducted under this study. Since the surveys varied n sample sizes and used different measurement methods, the reliability of the estimates derived from those surveys would also differ.

The field sample of 200 SFRs was carefully selected to be representative of the SFR population from the larger sample of 1200 telephone-surveyed SFRs. The latter sample was in turn selected from the tax assessor records of SFRs in four counties using a stratified proportional random sampling method. Because of this careful selection procedure, the sample of 200 SFRs should be quite representative of the basinwide SFR population in spite of its small size.

All exterior surfaces found in each field-surveyed SFR were measured by field surveyors with a target accuracy of ± 5 percent or better. Therefore, the basic estimates of exposed surface areas for SFRs are expected to have at least the same accuracy level. However, the accuracy of our estimates for exposed surfaces of individual materials could be less than ± 5 percent, for the following reasons:

1. As seen in the three test houses, field surveyors sometimes made errors in identifying substrate material types, particularly for material surfaces covered by paint and other lucent coatings.

2. Many materials were not found in all surveyed SFRs, particularly certain types of metals, roofing materials and synthetic materials, as well as enumeration items, which were found only in a few surveyed SFRs.

The first cause would induce additional errors in the estimates of individual material surfaces but not in the estimates of total exposed surface areas. Furethermore, these errors, if any, would have occurred primarily between similar types of material. For example, one team reported painted steel surface as "unidentified metal-painted" whereas the other team reported it as "galvanized steel-painted."

The second cause would increase sampling errors due to the so-called "binomial problems":

1. Since only a certain proportion, $p(<1)$, of the surveyed SFRs have the subject material, the effective sample size decreases from the original sample size, $n = 200$, to np; and

2. Since the number of SFRs with the material in the SCAB is now given by Np instead of N, the total number of SFRs, the basinwide total material surface is given by mNp, where m is the mean material surface per SFR with that material.

Therefore, the sampling error in the estimated basin total area for the material is given, for 95 percent confidence level, as:

$$E = 1.96 \text{ SQRT } [(1 + (1-p)/p)(1 + CV^2) - 1]/\text{SQRT } (np)$$

where CV is the coefficient of variation and is given by the ratio of the standard deviation to the mean. This equation reduces to:

$$E = 1.96\ CV/\sqrt{n} \qquad \text{for } P = 1$$

$$E \rightarrow \infty \qquad \text{for } P = 0$$

For a few selected material-finishes, sampling errors were computed and are summarized in Table 6-2.

For parcel-total exterior surface areas, the sample of 198 SFR measurements yields a sample error of 4 percent, which is less than the measurement error of 5 percent. For common material-finishes such as bare

block, bare concrete, painted stucco, bare aluminum, painted wood and fiberglass screen, the sampling errors remain small, 8 percent to 16 percent. However, for rather rare material-finishes such as painted block and painted wood shingle, the sampling errors exceed 100 percent. For moderately common material-finishes such as bare and painted galvanized steel, painted aluminum, bare wood shingle, aluminum screen and chain link, the sampling errors range from 25 percent to 50 percent.

TABLE 6-2. SAMPLING ERRORS IN BASINWIDE MATERIAL SURFACE AREAS OF SELECTED MATERIAL-FINISHES FOR SFRS (n = 198).

Material-Finish		Count	p	Mean	SD	CV	Percent Error	Exposed Area*
111	Block-Bare	152	.768	716	541	.756	16	1237
112	Block-Painted	18	.091	225	210	.933	204	47
131	Concrete-Bare	189	.955	1039	633	.609	9	2233
142	Stucco-Painted	161	.813	1658	721	.435	11	3036
411	Aluminum-Bare	185	.934	81	85	1.049	16	170
412	Aluminum-Painted	145	.732	194	238	1.227	25	319
431	Aluminum Screen-Bare	101	.510	64	60	.938	32	74
451	Galvanized Steel-Bare	83	.419	67	52	.776	36	63
452	Galvanized Steel-Painted	73	.369	59	53	.898	45	50
471	Chain Link-Bare	87	.439	660	843	1.277	47	653
712	Wood-Painted	198	1.000	1491	888	.596	8	3354
721	Wood Shingle-Bare	50	.253	2568	880	.343	51	1457
722**	Wood Shingle-Painted	2	.010	1360	1666	1.225	2187	31
771	Asphalt Roofing-Bare	119	.601	2002	812	.406	17	2703
801	Fiberglass Screen-Bare	180	.909	95	66	.695	12	196
Parcel Total		198	1.000	9104	2587	.284	4	20474

* In million square feet.

** Includes stained wood shingle.

Therefore, it can be said that for material-finishes found practically in every house, sampling errors are around 10 percent while for material-finishes found in about every second or third house, sampling errors are around 40 percent. For rare material-finishes which are found in less than one fifth of all houses, current estimates of the exposed surface areas may be too unreliable to be used for any quantitative assessment purposes.

Table 6-3 shows sampling errors for the estimated basinwide surface areas of similar selected materials found in NSFRs. However, unlike the sample for SFRs, the survey sample was not taken proportionately throughout the NSFR population (i.e., the sample was slightly biased). Therefore, the

sampling errors presented in the table should be considered only as bench marks rather than accurate reliability indicators.

TABLE 6-3. SAMPLING ERRORS IN BASINWIDE MATERIAL SURFACE AREAS OF SELECTED MATERIAL-FINISHES FOR NSFRs (n = 858)

Material-Finish		Count**	P	CV	Percent Error	Exposed Area*
111	Block-Bare	417	.486	2.283	33	166
112	Block-Painted	493	.575	1.643	21	463
131	Concrete-Bare	457	.533	2.552	33	1365
142	Stucco-Painted	851	.992	1.963	13	2023
411	Aluminum-Bare	151	.176	2.765	111	2
412	Aluminum-Painted	43	.050	2.275	322	303
441	Steel-Bare	84	.098	1.782	138	53
442	Steel-Painted	599	.698	4.218	41	148
451	Galvanized Steel-Bare	631	.735	1.657	16	31
471	Chain Link-Bare	172	.200	1.543	60	103
712	Wood-Painted	763	.889	7.674	58	405
721	Wood Shingle-Bare	30	.035	3.579	710	334
722	Wood Shingle-Painted	9	.010	0.943	896	4
771	Asphalt Roofing-Bare	817	.952	1.733	12	4421
791	Fiberglass-Bare	6	.007	1.437	1672	19
Cluster Total		858	1.000	1.895	10	14506

* In million square feet.

** Number of clusters measured

It should be noted that the coefficients of variation (CVs) for nearly all exposed surface areas of NSFRs are as large as or greater than unity, indicating an inherent large variation in exterior surfaces of NSFRs. This large variation was anticipated and was taken into account in the basic survey design by assigning a larger sample to NSFRs than to SFRs in spite of the opposite relationship in terms of their basinwide parcel counts: 858 vs 198 in the survey samples, and 1 million vs 2.2 million in the parcel populations.

Table 6-2 shows that despite the large sample (858) of NSFR clusters, the overall sampling error is 10 percent as opposed to 4 percent in the SFR sample of 198 parcels. For common materials such as painted stucco, bare asphalt roofing and bare galvanized steel (this is common for NSFRs), the sampling errors are small, 12 to 16 percent. However, another common material, painted wood, exhibits a large sampling error (58%) due to the extremely large coefficient of variations (CV = 7.7). For moderately common material-finishes

such as bare and painted block, bare concrete, painted steel, and chain link, the sampling errors are 20 to 60 percent.

More than a third of the material-finishes listed in the table are found less frequently than in every fifth NSFR: bare and painted aluminum, bare steel, bare and painted wood shingle, and bare fiberglass. All these material-finishes exhibit large sampling errors, over 100 percent. This is unfortunate because in the SFR sample most of those material finishes exhibited moderate sampling errors, around 40 percent.

One of the reasons why the NSFR sample has so many rare material-finishes exhibiting very large sampling errors seems to be that the material-finish resolution in the airphoto analysis of the NSFR sample is rather limited. In the nature of the remote sensing method, fine details of the study objects such as window frame materials, small trims of wood and other materials, and various minor attachments onto walls and eaves could not be quantified. Because of these omissions of the fine details, the proportions of NSFRs having such materials appeared smaller than they actually were.

For enumeration items, the number of items per house or cluster ranged from a few hundredths to a few tenths (with typical values around 0.1 to 0.3 (see Figures 3-21 and 4-13). At these probabilities, the sampling errors would not be very large for the sample sizes of 198 SFR parcels and 858 NSFR clusters. For example, at the probability of 0.2, the sampling error at 95 percent confidence level would be about 30 percent for the SFR sample while for the NSFR sample it would be about 15 percent (see Figure 6-1). Therefore, the total numbers of various enumeration items were indeed estimated with reasonable accuracy. However, their exposed material surfaces were estimated from measurements of only a few objects, subjectively selected. Therefore, possible biases (i.e., systematic errors) could be substantial for items whose sizes vary greatly (e.g., large TV antennas in SFRs and signs and billboards in NSFRs).

Errors in estimates for the infrastructure items may be rather similar to those of enumeration items: reasonable random sampling errors in estimates of the total numbers of material bearing items; and possible systematic errors in estimates of exposed material surfaces per item. However, we made a

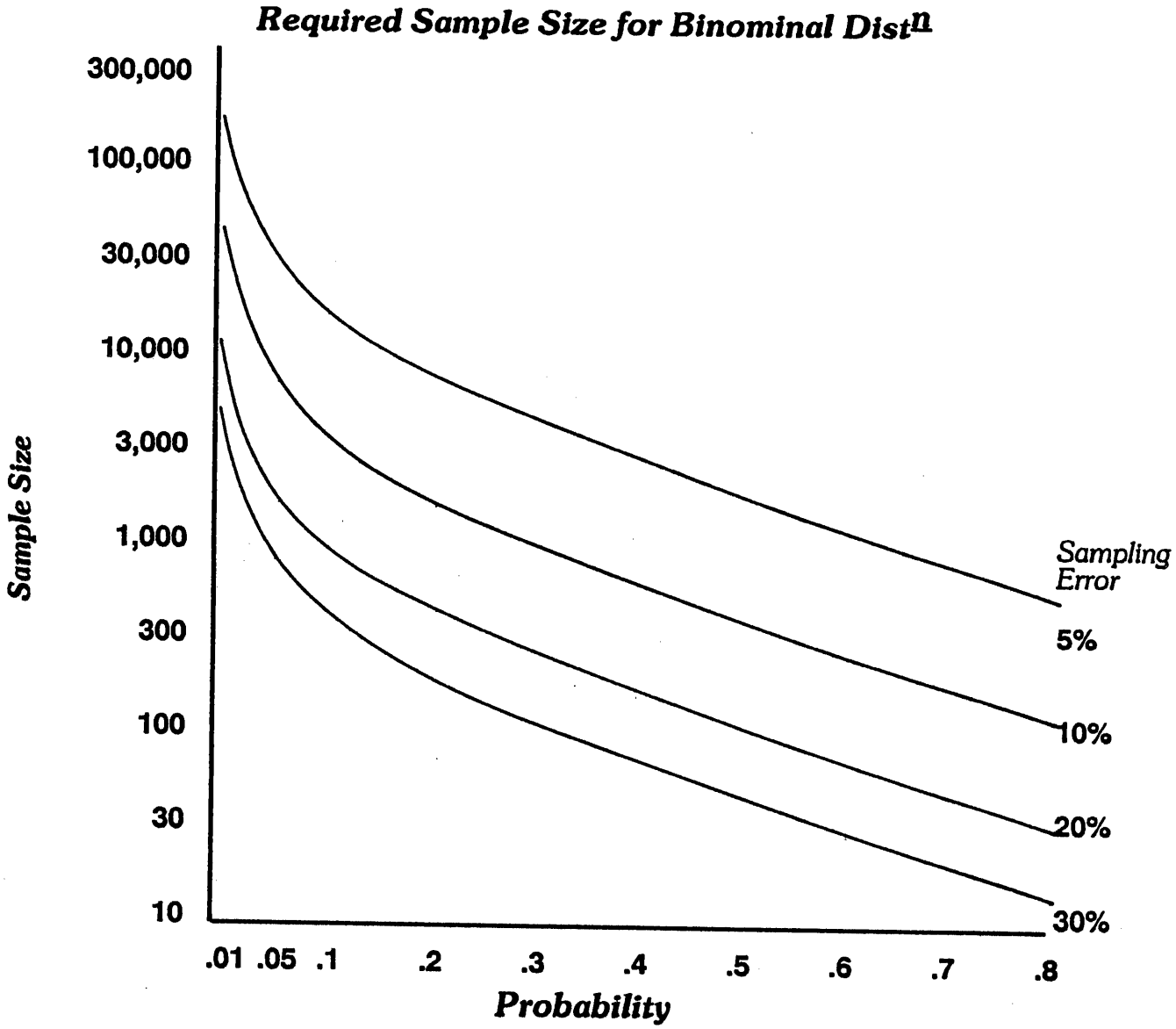

Figure 6-1. Required Sample Size Versus Probability of Finding Items.

deliberate effort to minimize such systematic errors by choosing appropriate, typical measurement samples from which the material factors were developed.

6.3 RECOMMENDATIONS

Based on the experience gained and the findings made in this study, we have a number of recommendations, some relating to possible future studies on the same or similar subjects and others for prospective users of the materials inventory data bases developed under this study. The latter are discussed in Section 6.3.1 and the former in Section 6.3.2.

6.3.1 RECOMMENDATIONS FOR PROSPECTIVE DATA BASE USERS

The present study was designed to develop a comprehensive, reliable inventory of materials-in-place in the SoCAB. For this purpose, representative samples of SFRs and NSFRs were selected from their statistical populations regardless of their geographical locations. This method of sampling proved to be effective for generating basinwide inventories of materials associated with SFRs and NSFRs. However, since the selection of survey samples was based solely on statistical considerations, results of the surveys may not be adequate to provide detailed spatial resolution regarding materials-in-place over the SoCAB.

For example, it is conceivable that exterior materials of SFR buildings in a given age-size stratum differ markedly from the coastal area to the inland area. This study assumes that such geographical differences would be small as compared to interclass differences between age-size groups of SFRs or between use-types of NSFRs.

Despite the limitation imposed by this assumption, the spatial distribution of materials-in-place can be achieved through the following procedures:

STEP 1 - Prepare Mapbook Statistics

Parcels in the tax assessor records are grouped by geographically specified mapbooks, whose locations and boundaries are clearly shown in the 1987 Thomas Guide, "Commercial Street Atlas, Assessor's Edition". For all these mapbooks in the SoCAB, VRC has generated statistics of parcel counts by use-types: SFR, SMFR, LMFR, RCOND, SNR, LNR, MJR, VAC, and UNK for Los Angeles County; and MFR, RCOND, NR, MH, AGR, VAC, and UNK for Composite County. These mapbook statistics provide the numbers and types of parcels in any areas of interest.

For SFR parcels in Los Angeles County, VCR has submitted to ARB the RESTAT data base, which provides at mapbook level the number of parcels and their average livable space for each of the three time periods: OLD (pre-1946), MED (1946-1964), and NEW (post-1964).

STEP 2 - Materials-in-Place by Subregion

For any subregions such as those delineated by different pollution contours, say, high, medium, low, mapbook statistics or RESTAT can easily be aggregated into subregions by superimposing the pollution contour map on the Thomas Bros. Maps showing boundaries of all mapbooks. Then, materials-in-place in the subregion are given by taking the sum of products of the material-finish profiles and the aggregated parcel counts by use-type or age-size group.

To illustrate the above procedures, a special inventory of materials associated with SFRs and NSFRs was calculated for Orange County.

Material Inventory for Orange County

Orange County is one of the three counties forming "Composite County". Therefore, its materials inventories should be inferred from those of Composite County. In Orange County, there are 434,013 SFR parcels and 128,406

NSFR parcels (see Table 2-1). Using these parcel statistics exposed material surfaces associated with SFRs and NSFRs can easily be calculated from the results for Composite County.

Table 6-4 shows county total exposed surface areas by material-finish for SFRs in Orange County. As seen from the table, total exposed surface areas are estimated by products of the number of SFR parcels in the county and mean exposed surface areas per parcel, which are given in Table 3-16 for various material-finish combinations. The county total exposed surface area is estimated to be 4047 million ft2, 52 percent of Composite total or 20 percent of SoCAB total.

For materials associated with NSFRs, we must calculate total exposed surface areas separately for the following seven use-types: MFR, RCOND, NR, MH, AGR, VAC, and UNK. Table 6-5 lists relevant use-type values of the three necessary quantities: (1) the number of NSFR parcels by use-type; (2) the percent of those parcels with building; and (3) the mean exposed surface area. By taking products of these three quantities, county total exposed surface areas are estimated in Table 6-4 for all seven use-types. Of the total exposed area of 3000 million ft2 for all NSFR parcels, NR accounts for the most with 49 percent. Other NSFR use-types with substantial contributions are: MFR with 22 percent, VAC with 17 percent, and RCOND with 11 percent. MH, AGR and UNK contribute insignificantly, with 1 percent for the three use-types combined.

TABLE 6-4. MEAN AND TOTAL EXPOSED SURFACE AREAS BY MATERIAL-FINISH FOR SFR PARCELS IN ORANGE COUNTY

	Material-Finish	Per Parcel[a]	County Total[b]
111	Block - Bare	536	233
112	Block - Painted	1	0
121	Brick - Bare	179	78
122	Brick - painted	7	3
131	Concrete - Bare	962	418
132	Concrete - Painted	36	16
141	Stucco - Bare	497	216
142	Stucco - Painted	1181	513
151	Tile - Bare	4	2
152	Tile - Painted	-	-
161	Terra Cotta - Bare	255	111
181	Cement Shingle - Bare	125	54
391	Unspecified Stone - Bare	23	10
411	Aluminum - Bare	67	29
412	Aluminum - Painted	133	58
421	Anodized Aluminum - Bare	6	3
431	Aluminum Screen - Bare	20	9
441	Steel - Bare	7	3
442	Steel - Painted	7	3
451	Galvanized Steel - Bare	22	10
452	Galvanized Steel - Painted	15	7
461	Iron - Bare	-	-
462	Iron - Painted	14	6
471	Chain Link - Bare	325	141
501	Chicken Wire - Bare	44	19
591	Unspecified Metal - Bare	1	0
592	Unspecified Metal - Painted	2	1
611	Nylon - Bare	-	-
711	Wood - Bare	610	265
712	Wood - Painted	667	289
715	Wood - Stained	77	33
721	Wood Shingle - Bare	957	415
722	Wood Shingle - Painted	-	-
725	Wood Shingle - Stained	-	-
731	Plastic - Bare	-	-
741	Vinyl (hard) - Bare	-	-
742	Vinyl (hard) - Painted	-	-
751	Tar - Bare	212	92
761	Asphalt - Bare	98	43
771	Asphalt Roofing - Bare	903	392
781	Glass - Bare	217	94
791	Fiberglass - Bare	16	7
801	Fiberglass Screen - Bare	87	38
811	I/O Carpet - Bare	7	3
	Total Area	9324	4047

Note: Due to round-off errors, the sum of elements may not equal the total.

a,b In square feet per parcel and million ft^2, respectively.

TABLE 6-4. MEAN AND TOTAL EXPOSED SURFACE AREAS BY MATERIAL-FINISH FOR SFR PARCELS IN ORANGE COUNTY

	Material-Finish	Per Parcel[a]	County Total[b]
111	Block - Bare	536	550
112	Block - Painted	1	21
121	Brick - Bare	179	235
122	Brick - painted	7	16
131	Concrete - Bare	962	993
132	Concrete - Painted	36	59
141	Stucco - Bare	497	302
142	Stucco - Painted	1181	1350
151	Tile - Bare	4	4
152	Tile - Painted	-	1
161	Terra Cotta - Bare	255	178
181	Cement Shingle - Bare	125	73
391	Unspecified Stone - Bare	23	32
411	Aluminum - Bare	67	76
412	Aluminum - Painted	133	142
421	Anodized Aluminum - Bare	6	4
431	Aluminum Screen - Bare	20	33
441	Steel - Bare	7	4
442	Steel - Painted	7	12
451	Galvanized Steel - Bare	22	28
452	Galvanized Steel - Painted	15	22
461	Iron - Bare	-	-
462	Iron - Painted	14	19
471	Chain Link - Bare	325	290
501	Chicken Wire - Bare	44	22
591	Unspecified Metal - Bare	1	3
592	Unspecified Metal - Painted	2	4
611	Nylon - Bare	-	-
711	Wood - Bare	610	422
712	Wood - Painted	667	1492
715	Wood - Stained	77	63
721	Wood Shingle - Bare	957	
722	Wood Shingle - Painted	-	13
725	Wood Shingle - Stained	-	1
731	Plastic - Bare	-	1
741	Vinyl (hard) - Bare	-	2
742	Vinyl (hard) - Painted	-	-
751	Tar - Bare	212	274
761	Asphalt - Bare	98	157
771	Asphalt Roofing - Bare	903	1204
781	Glass - Bare	217	229
791	Fiberglass - Bare	16	27
801	Fiberglass Screen - Bare	87	86
811	I/O Carpet - Bare	7	12
	Total Area	9324	9104

Note: Due to round-off errors, the sum of elements may not equal the total.

a,b In square feet per parcel and million ft^2, respectively.

TABLE 6-5. TOTAL EXPOSED SURFACE AREAS BY NSFR USE-TYPE IN ORANGE COUNTY.

Use-Type	# Parcels[a]	% Parcels w/Bldg[b]	Exposed Area per Parcel[c]	Total Exposed Area in 10^6 ft^2
MFR	26,152	98.3	25,038	644
RCOND	20,267	91.5	17,429	323
NR	38,685	98.6	37,937	1,447
MH	3,884	85.5	8,484	28
AGR	526	71.4	20,731	8
VAC	38,782	51.3	25,810	513
UNK	110	12.8	41,455	1
Total	128,406	--	--	2,964

a,b,c From Tables 2-1, 4-10 and 4-7, respectively.

Total exposed surface areas by material-finish for each use-type can easily be calculated using the mean exposed surface areas listed in Table 4-7 in the same manner as used in Table 6-4 for SFRs. Treatments for enumeration items associated SFRs and NSFRs are also essentially the same; straight scale-up of the number density of each item and its material factor to the total numbers of SFR and NSFR parcels in the county.

Since the material inventory data bases developed under this study are completely disaggregated in regard to material, finish, component and use-type, the material-finish profile can be computed not only for "parcel totals" or "building primaries" but also for roofs, walls, and painted surfaces. As to spatial resolution, the subregion can be as small as a mapbook, which ranges in size from less than half a square mile to several tens of square miles.

Spatial allocation of materials associated with infrastructures may require an approach different from the one described above because estimates of their materials-in-place are not based on mapbooks. The spatial allocation of infrastructure materials can be made according to either their apparent correlation with "population" or their actual locations:

Population Surface streets and distribution poles appear to be distributed in proportion to the distribution of human populations or building population. Therefore, the spatial distribution of materials

associated with these facilities may be assumed proportional to the housing density or the population density over the SoCAB.

Actual Location Freeways, railroads, channelized waterways and transmission towers have their own distributions. Therefore, one must allocate materials associated with these infrastructures according to their actual locations.

6.3.2 RECOMMENDATIONS FOR FUTURE STUDIES

The present study has advanced a materials inventory methodology and has generated a more comprehensive inventory of materials-in-place than any earlier studies. However, there are still several subject areas that this study has not addressed and for which future studies appear to be warranted:

Additional NSFR Study Although this study has achieved a tremendous improvement in inventorying materials-in-place in NSFRs, there are yet several important areas unaddressed in this study, such as highrise buildings, industrial complexes, sport stadia and amusement parks. These facilities are rather small in numbers but contain inordinate amounts of economically significant materials. To inventory materials associated with these facilities requires a more intensive approach than the general statistical approach used here.

Mobile Properties The present study has focused on inventorying materials associated with stationary properties such as buildings and infrastructures. However, materials associated with cars, aircraft and boats are also susceptible to effects of acid deposition. Since marginal costs of accelerated repainting due to acid deposition are a major economic factor in material damage, an accurate inventory of material surfaces associated with these mobile properties appears to be needed to improve economic assessment of material damage.

Data Analysis Data analyses performed in this study were limited to descriptive statistics. However, in extrapolating to non-surveyed areas or assessing errors in individual estimates, more elaborate analyses should be performed. These analyses include regression analysis and error or sensitivity analysis. Although not included in

this report, material surfaces of SFRs and NSFRs are found to be highly correlated with total livable space or building footprint. Such regression relations may improve accuracy in spatial extrapolation of the present materials inventory or efficiency for future materials inventory studies.

Spatial Modeling To improve the spatial aspects of a materials inventory, a different way of selecting sampling sites, one that would emphasize an areas' homogeneity in building construction type and age, could be employed as substitute for or in conjunction with use of the tax assessor's mapbooks.

The method recommended here is the delineation and use of urban terrain zones. These are based on the identification of homogeneous combinations of building construction type, building age, associated patterns of placement on land parcels, and function. The method has the advantage of dealing, with a zone, almost entirely with buildings that have the same type of wall and roof materials.

Use of these sampling frames would offer an approach to spatial modeling of the SoCAB. For instance, known features of old core urban areas (e.g., Pasadena) could be readily differentiated from new industrial or apartment areas. The spatial model could take account of the early centers of urban development, which occur throughout the basin, and the expansion of suburban accretions -- both residential and non residential -- form these original centers.

7.0 REFERENCES

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List of Appendices

Appendix A: Telephone Questionnaire

VRC NO._____

VRC TELEPHONE QUESTIONNAIRE 1058-1

Int*	Date	Time	Result**	Comments
1.				
2.				
3.				
4.				
5.				

* Interviewer's Initials

** C = Complete
CB = Call back (when? who? number?)
R = Flat refusal (why?)
T = Respondent Terminated (why?)
D = Disconnected No., Not in Service w/no new no., or Dead Line
W = Wrong No. (reason?)
B = Line busy
A = Answer machine/service
N = No answer (after 6 to 8 rings)
L = Language problem (specify)
V = Referred to VRC

MAKE FIVE ATTEMPTS TO CONNECT BEFORE ABANDONING THIS LOCATION.

PHONE NUMBER: (___)_____.

Q1. Hello. I'm _____ from Valley Research. Am I calling _____?

IF NO, SPECIFY RIGHT ADDRESS HERE, THEN TERMINATE.

_____

Q2. May I speak to _____?

IF PERSON(S) IS UNAVAILABLE, ASK TO SPEAK TO A RESPONSIBLE PERSON OR DETERMINE: (1) AVAILABILITY OF RESPONSIBLE PERSON, OR (2) OWNER'S PHONE NUMBER IF THEY DO NOT RESIDE HERE.

ONCE YOU HAVE THE RIGHT PERSON ON THE PHONE, BEGIN WITH PAGE 3. BE SURE TO RECORD THE "VRC NO." ON PAGE 3. FOR L.A. COUNTY HOMES, RECORD THE FOLLOWING DATA IN THE APPROPRIATE QUESTIONS:

(Q3) SQUARE FEET = _____

(Q4) YEAR BUILT = _____

VRC NO._____

Your home has been selected for inclusion in a survey being done for the California Air Resources Board. The aim is to collect information to estimate the impact of air pollution on building structures found in your area. The questions I need to ask you are related to the exterior features of your home.

ANSWER RESPONDENT'S QUESTIONS BY USING THE PROJECT INFO SHEET.

I'll begin by asking some general questions about your home.

FOR L.A. COUNTY HOMES, START HERE.

Q3. I understand that your house has _____ square feet of livable space excluding the garage, is this right?

YES.....1

NO.....2

→ SPECIFY:_____ FT^2

NOT SURE.....3

Q4. Your home is reportedly built in _____, is this correct?

YES.....1

NO.....2

→ SPECIFY: _____

NOT SURE.....3

SKIP TO Q7

FOR NON-L.A. COUNTY HOMES, START HERE

Q5. Excluding the garage, is your home's livable square footage

1,000 square feet or less,.....1
1,001 to 1,500 square feet,.....2
1,501 to 2,000 square feet, or.....3
2,001 or more square feet?.....4
DON'T KNOW.....5

Q6. Was your home originally built

Before 1946.....1
Between 1946 and 1964.....2
Between 1965 and 1986, or.....3
Since 1986?.....4
DON'T KNOW.....5

Q7. Is your house

Single story,...**SKIP TO Q9**.....1

Two story, or.....2

Split level?.....3

Q8. Considering the total livable square footage, would you say the square footage above the first floor is nearly equal to

50 percent,.....1

35 percent, or.....2

20 percent of that total?.....3

Q9. Was the garage remodeled to, say, an office or bedroom?

YES.....1

NO.....2

DON'T HAVE A GARAGE...**SKIP TO Q12**.....3

Q10. Is your garage (remodeled or otherwise)

Attached, or.....1

Detached from the house?.....2

REMEMBER THIS FACT. IT WILL BE IMPORTANT LATER.

Q11. Is (was) the garage made to hold

One car,.....1

Two cars,.....2

Three cars, or.....3

More?.....4

→ How many? _____

Q12. I am now going to read a list of common roof materials. Please stop me when I mention the major material that covers your main house (detached garage) roof.

	MAIN HOUSE	DETACHED GARAGE?
Tar,	1	1
Asphalt shingle,	2	2
Wood shingle/shake,	3	3
Tile,	4	4
Slate, or	5	5
Some other material?	6	6
SPECIFY:	_____	_____

"MAIN HOUSE" INCLUDES ATTACHED GARAGE, IF PRESENT. REPEAT THE QUESTION FOR A DETACHED GARAGE.

Q13. Is the roof on the main house (detached garage)

	MAIN HOUSE	DETACHED GARAGE?
Sloped	1	1
Flat, or	2	2
Both?	3	3

Q14. Are the eaves on the main house (detached garage)

	MAIN HOUSE	DETACHED GARAGE
Less than 2 feet,	1	1
2 to 4 feet,	2	2
Greater than 4 feet, or	3	3
Are there no eaves?	4	4

Q15. Does the main house (detached garage) have

	MAIN HOUSE	DETACHED GARAGE
Both rain gutters & downspouts	1	1
Rain gutters only	2	2
Downspouts only...SKIP TO Q17 IF FOR BOTH	3	3
Neither.....SKIP TO Q19 IF FOR BOTH	4	4

Q16. Is the rain gutter coverage on the main house (detached garage) over

	MAIN HOUSE	DETACHED GARAGE
All four sides,	1	1
Three sides,	2	2
Two sides,	3	3
One side, or	4	4
Just over entry ways?	5	5

Q17. How many downspouts are there on the main house (detached garage)?

	MAIN HOUSE	DETACHED GARAGE
NUMBER	_____	_____

Q18. Are your rain gutters and downspouts chiefly made of

- Bare galvanized steel,.....1
- Painted galvanized steel,.....2
- Bare aluminum,.....3
- Painted aluminum,.....4
- Bare vinyl,.....5
- Painted vinyl, or.....6
- Some other material?.....7
  - SPECIFY:_____

Q19. Does the house have a chimney?

YES.....1

→ How many? _____

NO.....SKIP TO Q22.....2

Q20. Is chimney number (...) on an outside wall or in the interior of the house?

	NO. 1	NO. 2	NO. 3
SIDE	1	1	1
INTERIOR	2	2	2

Q21. Is the outdoor exposed material on chimney number (...)

	NO. 1	NO. 2	NO. 3
Bare brick,	1	1	1
Painted brick,	2	2	2
Painted wood,	3	3	3
Stained wood, or	4	4	4
Some other material?	5	5	5
→ SPECIFY:	_____	_____	_____

Q22. I am going to list of a few common items found on roofs. Please tell me if you have them or not.

CIRCLE ALL THAT APPLY

TV Antenna.....1

Radio antenna or tower.....2

Satellite dish.....3

Skylight.....4

Refrigerated A/C unit.....5

Evaporative cooler.....6

ASK Q23 TO Q24 FOR ONE SIDE OF THE HOUSE AT A TIME. ASK Q24 AND Q25 FOR ONE WINDOW AT A TIME, REPEATING FOR EACH WINDOW ON THE SIDE BEFORE PROCEEDING TO THE NEXT SIDE. TAKE THE SIDES IN A CLOCKWISE ORDER: FRONT, LEFT,BACK AND FINALLY THE RIGHT.

Q23. Now, starting with the (...) of the house, how many windows are there excluding those found in doors? A single window is defined as all the glass found in a single window frame or casing.

Q24. Considering the first (second, etc.) window on this side, would you say it is large like a bay window, medium in size like a typical bedroom window, or small like a small kitchen or bathroom window?

Q25. I am going to read a list of common exterior window coverings. Please tell me if you have them or not on this window.

CIRCLE ALL THAT APPLY

Aluminum screen with full coverage,.....1

Aluminum screen with 1/2 coverage,.....2

Fiberglass screen with full coverage,....3

Fiberglass screen with 1/2 coverage,.....4

Security bars,.....5

Painted aluminum awning,.....6

Fabric awning,or 7

Other awning type?.....8

→ SPECIFY IN "Oth"

NONE OF THE ABOVE.....9

NOW GO TO Q24 FOR NEXT WINDOW OR Q23 FOR NEXT SIDE.

WHEN THE FIRST SIX WINDOWS ON ALL SIDES ARE COMPLETE, GO TO Q26.

WINDOW	SIZE (Q24)			WINDOW COVERINGS (Q25)								
				SCREENS				SECURITY BARS	AWNING			
				ALUMIN		FIBERGLS						
	Lg.	Med.	Sm.	Full	1/2	Full	1/2		Ptd Al.	Fab.	Oth.	N/A
FRONT - TOTAL NUMBER (Q23): _____												
#1	1	2	3	1	2	3	4	5	6	7	_____	9
#2	1	2	3	1	2	3	4	5	6	7	_____	9
#3	1	2	3	1	2	3	4	5	6	7	_____	9
#4	1	2	3	1	2	3	4	5	6	7	_____	9
#5	1	2	3	1	2	3	4	5	6	7	_____	9
#6	1	2	3	1	2	3	4	5	6	7	_____	9
LEFT SIDE - TOTAL NUMBER: _____												
#1	1	2	3	1	2	3	4	5	6	7	_____	9
#2	1	2	3	1	2	3	4	5	6	7	_____	9
#3	1	2	3	1	2	3	4	5	6	7	_____	9
#4	1	2	3	1	2	3	4	5	6	7	_____	9
#5	1	2	3	1	2	3	4	5	6	7	_____	9
#6	1	2	3	1	2	3	4	5	6	7	_____	9
BACK - TOTAL NUMBER: _____												
#1	1	2	3	1	2	3	4	5	6	7	_____	9
#2	1	2	3	1	2	3	4	5	6	7	_____	9
#3	1	2	3	1	2	3	4	5	6	7	_____	9
#4	1	2	3	1	2	3	4	5	6	7	_____	9
#5	1	2	3	1	2	3	4	5	6	7	_____	9
#6	1	2	3	1	2	3	4	5	6	7	_____	9
RIGHT SIDE - TOTAL NUMBER: _____												
#1	1	2	3	1	2	3	4	5	6	7	_____	9
#2	1	2	3	1	2	3	4	5	6	7	_____	9
#3	1	2	3	1	2	3	4	5	6	7	_____	9
#4	1	2	3	1	2	3	4	5	6	7	_____	9
#5	1	2	3	1	2	3	4	5	6	7	_____	9
#6	1	2	3	1	2	3	4	5	6	7	_____	9

Q26. Considering all the windows we just talked about, would you say that the typical outside window frame or casing material is

Painted wood,.....1

Stained wood,.....2

Painted aluminum,.....3

Bare aluminum,.....4

Anodized aluminum,.....5

Painted steel,.....6

Bare steel, or.....7

Some other material?.....8

→ SPECIFY: _____

I will now ask you some questions about the various doors. As with the windows, I will start with the front of the house.

ASK THE NEXT FOUR QUESTIONS FOR EACH SIDE, REPEATING THE LAST THREE FOR EACH DOOR ENCOUNTERED. AGAIN, TAKE THE SIDES IN A CLOCKWISE ORDER.

Q27. Starting with the (...) of the main house, how many doors to the outside are there? **RECORD NUMBER.**

Q28. Consider the first (second, etc.) door. Is the door type a

Garage (NOTE: FOR CARS),.....1

Solid entry,.....2

Solid entry with window,.....3

French with glass, or.....4

Sliding glass?.....5

FOR DOUBLE DOORS, SUCH AS A DOUBLE ENTRY DOOR, INDICATE BY PUTTING A "2" NEXT TO THE DOOR NUMBER.

Q29. Is the door made of

Painted wood,.....1

Stained wood,.....2

Bare aluminum,.....3

Painted aluminum, or.....4

Some other material?.....5

→ SPECIFY IN CHART

Q30. Is the door equipped with either an

Aluminum screen **(Al)**,.....1

Fiberglass screen **(F-glass)**, or.....2

No screen?.....9

DOORS (Q27)	DOOR TYPE (Q28)					MATERIAL TYPE (Q29)					SCREEN (Q30)		
						WOOD		ALUMINUM					
	Garage/Solid/W-glass/French/Slide					Paint/Stain		Bare/Paint		Other	Al/F-glass/No		
FRONT - TOTAL NUMBER (Q27): _____													
#1	1	2	3	4	5	1	2	3	4	_____	1	2	9
#2	1	2	3	4	5	1	2	3	4	_____	1	2	9
#3	1	2	3	4	5	1	2	3	4	_____	1	2	9
#4	1	2	3	4	5	1	2	3	4	_____	1	2	9
LEFT - TOTAL NUMBER: _____													
#1	1	2	3	4	5	1	2	3	4	_____	1	2	9
#2	1	2	3	4	5	1	2	3	4	_____	1	2	9
#3	1	2	3	4	5	1	2	3	4	_____	1	2	9
#4	1	2	3	4	5	1	2	3	4	_____	1	2	9
BACK - TOTAL NUMBER: _____													
#1	1	2	3	4	5	1	2	3	4	_____	1	2	9
#2	1	2	3	4	5	1	2	3	4	_____	1	2	9
#3	1	2	3	4	5	1	2	3	4	_____	1	2	9
#4	1	2	3	4	5	1	2	3	4	_____	1	2	9
RIGHT - TOTAL NUMBER: _____													
#1	1	2	3	4	5	1	2	3	4	_____	1	2	9
#2	1	2	3	4	5	1	2	3	4	_____	1	2	9
#3	1	2	3	4	5	1	2	3	4	_____	1	2	9
#4	1	2	3	4	5	1	2	3	4	_____	1	2	9
#5	1	2	3	4	5	1	2	3	4	_____	1	2	9

Q31. I will now ask you some questions about outside walls. Considering all but the front of the house, would you say that the main or principle wall material on the sides and back is

Painted stucco,.....1

Painted wood,.....2

Stained wood,.....3

Painted aluminum, or.....4

Some other material?.....5

→ SPECIFY:_____

BE CLEAR THAT, EXCEPT FOR WOOD TRIM AROUND DOORS, WINDOWS, ETC. THE MAIN MATERIAL IS THE MAJOR MATERIAL. AGAIN, REMEMBER TO EXCLUDE DOORS, WINDOWS, AND CHIMNEYS.

Q32. Considering the total surface area of the front of the house, would you estimate the doors, windows, and chimneys to cover

Less than 1/4,.....1

1/4 TO 1/2,.....2

1/2 TO 3/4, or.....3

More than 3/4 of that total?.....4

Q33. I am going to list common materials typically found on the front wall of homes. Please tell me if you have them or not.

CIRCLE ALL THAT ARE YES

Painted wood.....1

Painted stucco.....2

Painted brick.....3

Painted block.....4

Painted aluminum.....5

Stained wood.....6

Bare brick.....7

Bare block.....8

Bare stone.....9

Any other not mentioned?.....10

SPECIFY:_____

_____

FOR EACH MATERIAL IDENTIFIED IN Q33, ASK Q34.

Q34. Considering just the front wall area, that is, the front of the house minus doors, windows, and chimneys, would you say that the (**REAFFIRM THE MATERIAL**) portion covers

Less than 1/4 of the remaining wall area.....1

1/4 TO 1/2 of the remaining wall area.....2

1/2 TO 3/4 of the remaining wall area.....3

More than 3/4 of the remaining wall area, or.....4

All of the wall area?.....5

CIRCLE THE APPROPRIATE CODE NUMBER IN THE CHART. THEN CONTINUE WITH THE MATERIAL LIST AND QUESTION AS BEFORE.

MAIN HOUSE FRONT WALL
(Q34)

MATERIAL	ESTIMATED WALL COVERAGE				
	Less than 1/4	1/4 to 1/2	1/2 to 3/4	More than 3/4	All
PAINTED					
WOOD	1	2	3	4	5
STUCCO	1	2	3	4	5
BRICK	1	2	3	4	5
BLOCK	1	2	3	4	5
ALUMINUM	1	2	3	4	5
BARE					
STAINED WOOD	1	2	3	4	5
BRICK	1	2	3	4	5
BLOCK	1	2	3	4	5
STONE	1	2	3	4	5
OTHER					
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

IF NO DETACHED GARAGE (SEE Q10), SKIP TO Q37

Q35. Consider now the detached garage. Would you say its chief wall material is:

Painted stucco,.....1

Painted wood,.....2

Stained wood,.....3

Painted aluminum, or.....4

Some other material?.....5

→ SPECIFY:_____

Q36. If present, is the garage door:

Painted wood,.....1

Stained wood,.....2

Painted aluminum, or.....3

Some other material?.....4

→ SPECIFY:_____

Q37. I will now ask you some questions about the fences around the house. Let us start in the backyard first and work our way around. I am going to read a list of typical fence material, and I would like you to stop me when the material for the backyard fence is mentioned.

INSTRUCTIONS: (1) IF THE APPROPRIATE MATERIAL FOR THE FENCE IN QUESTION IS NOT LISTED, YOU MUST THEN QUESTION THE PERSON TO DETERMINE IT.

(2) ONCE THE MATERIAL HAS BEEN ESTABLISHED, QUERY THE PERSON AS TO FENCE TYPE, HEIGHT, AND LENGTH BY THE CATEGORIES LISTED.

(3) REPEAT THIS PROCESS AS YOU SYSTEMATICALLY GO CLOCKWISE AROUND THE HOUSE.

(4) IF YOU FIND MULTIPLE FENCES OF THE SAME MATERIAL, SIMPLY PLACE A SECOND (OR MORE AS NEEDED) SET OF NOTATIONS IN THE "MATERIAL TYPE" ROW. FOR EXAMPLE, SAY YOU FOUND TWO BLOCK FENCES THAT WERE BOTH SOLID, BUT WERE 5 FEET HIGH BY 45 FEET LONG AND 8 FEET HIGH BY 120 FEET LONG, RESPECTIVELY. YOU WOULD RECORD THIS SITUATION BY:

MATERIAL TYPE	HEIGHT (IN FEET)			LENGTH (IN FEET)			
	<4	4-6	>6	<50	50-150	150-300	>300
BLOCK	1	(2)[1]	(3)[2]	(1)[1]	(2)[2]	3	4

WHERE "1" INDICATES THE FIRST FENCE AND "2" THE SECOND.

(5) BE SURE TO INCLUDE FENCES IN THE YARD SUCH AS THOSE SURROUNDING POOLS.

FENCES
(Q37)

MATERIAL TYPE	HEIGHT (IN FEET)			LENGTH (IN FEET)			
	<4	4-6	>6	<50	50-150	150-300	>300
PAINTED							
WOOD							
SOLID	1	2	3	1	2	3	4
PICKET	1	2	3	1	2	3	4
RAIL	1	2	3	1	2	3	4
STUCCO	1	2	3	1	2	3	4
BRICK	1	2	3	1	2	3	4
BLOCK	1	2	3	1	2	3	4
WROUGHT IRON	1	2	3	1	2	3	4
BARE							
STAINED WOOD							
SOLID	1	2	3	1	2	3	4
PICKET	1	2	3	1	2	3	4
RAIL	1	2	3	1	2	3	4
BRICK	1	2	3	1	2	3	4
BLOCK	1	2	3	1	2	3	4
STONE	1	2	3	1	2	3	4
CHAIN LINK	1	2	3	1	2	3	4
OTHER*							
_____	1	2	3	1	2	3	4
_____	1	2	3	1	2	3	4
_____	1	2	3	1	2	3	4

* For example, bare brick posts with wood rails, painted block posts with wrought iron, bare wood frame with fiberglass, etc.

Q38. Do you have a car port for

One,.....1

Two, or.....2

More cars, or.....3

→ SPECIFY:_____

Don't have one....**SKIP TO Q41**.....4

Q39. Is the car port frame made of

Painted wood,.....1

Stained wood,.....2

Painted steel, or.....3

Some other material?.....4

→ SPECIFY:_____

Q40. Is the car port's roof material

Painted wood,.....1

Stained wood,.....2

Asphalt Shingle,.....3

Painted Aluminum,.....4

Fiberglass, or.....5

Some other material?.....6

→ SPECIFY:_____

Q41. Do you have a patio not around a pool or spa?

YES.....1

→ How many? _____

NO.....**SKIP TO Q47**.....2

Q42. What is the dimension of patio number (...)?

(e.g., 20 feet by 30 feet)

NO. 1: _____

NO. 2: _____

NO. 3: _____

Q43. Is the floor of patio number (...) made of

	NO. 1	NO. 2	NO. 3
Bare concrete, or	1	1	1
Some other material?	2	2	2
→ SPECIFY	_____	_____	_____

Q44. Is patio number (...) covered?

	NO. 1	NO. 2	NO. 3
YES	1	1	1
NO	2	2	2

IF ALL NO, SKIP TO Q47. FOR EACH YES, ASK Q45 AND Q46.

Q45. Is the frame for patio number (...) made of

	NO. 1	NO. 2	NO. 3
Painted wood,	1	1	1
Stained wood,	2	2	2
Painted steel, or	3	3	3
Some other material?	4	4	4
→ SPECIFY	_____	_____	_____

Q46. Is the patio roof material for patio number (...) made of

	NO. 1	NO. 2	NO. 3
Painted wood,	1	1	1
Stained wood,	2	2	2
Asphalt shingle,	3	3	3
Painted aluminum,	4	4	4
Fiberglass, or	5	5	5
Some other material?	6	6	6
SPECIFY	_____	_____	_____

Q47. Do you have a non-grass walkway nearly

All around the house,.....1

About half way around, or.....2

Don't have any non-grass walkways?.....**SKIP TO Q49**.....3

Q48. Is the walkway chiefly made of

Bare concrete,.....1

Bare brick, or.....2

Some other material?.....3

SPECIFY:_____

Q49. Is your drive way made of

Bare concrete,.....1

Asphalt,.....2

Some other material, or.....3

SPECIFY:_____

Don't have a driveway?....**SKIP TO Q51**....4

Q50. What is the approximate square footage of the driveway?

BY SQUARE FOOTAGE: _____

BY DIMENSIONS: _____

Q51. Do you have a pool or spa?

	POOL	SPA
YES	1	1
NO	2	2

SKIP TO Q56 IF BOTH NO.

Q52. Is the pool/spa

	POOL	SPA
Above ground, or	1	1
Below ground?	2	2

Q53. Is the decking for the pool/spa

	POOL	SPA
Bare concrete,	1	1
Bare brick, or	2	2
—Some other material?	3	3

—— SPECIFY: _____ _____

Q54. What is the approximate square footage of the pool/spa deck?

	POOL	SPA
BY SQUARE FOOTAGE:	_____ ft.2	_____ ft.2
BY DIMENSIONS:	_____	_____

Q55. Is the pool/spa heated?

	POOL	SPA
YES	1	1
NO	2	2

Q56. I am going to list five typical outdoor accessories. Please tell me if you have them or not.

CIRCLE ALL THAT APPLY

Aluminum yard shed.....1

Wood yard shed.....2

Wood gazebo.....3

Satellite dish.....4

Refrigerated A/C unit.....5

Finally, I would like to now ask two general questions that will help us validate our sample.

Q57. First, how many people live in your household?_____

Q58. Second, how many of that total are male?_____

Thank you.

Appendix B: Material-Finish Codes

MATERIAL CODING CHART FOR SFR FIELD SURVEY

Material (1st 2-digits)

Mortar

11	Block
12	Brick
13	Concrete
14	Stucco
15	Tile
16	Terra Cotta
17	Plaster
18	Cement Shingle
19	Unspecified Mortar

Stone

31	Fieldstone
32	Granite
33	Limestone
34	Marble
35	Volcanic
36	Slate
39	Unspecified Stone

Metal

41	Aluminum
42	Anodized Aluminum
43	Aluminum Screens
44	Steel
45	Galvanized Steel
46	Iron
47	Chain Link
48	Tin
49	Copper
50	Chicken Wire
59	Unspecified Metal

Textile

61	Nylon
62	Canvas
63	Unspecified Textile

Material (1st 2-digits)

Other

71	Wood
72	Wood Shingle
73	Plastic
74	Vinyl (hard)
75	Tar
76	Asphalt
77	Asphalt Roofing*
78	Glass
79	Fiberglass
80	Fiberglass Screen
81	I/O Carpet
99	Unknown Material

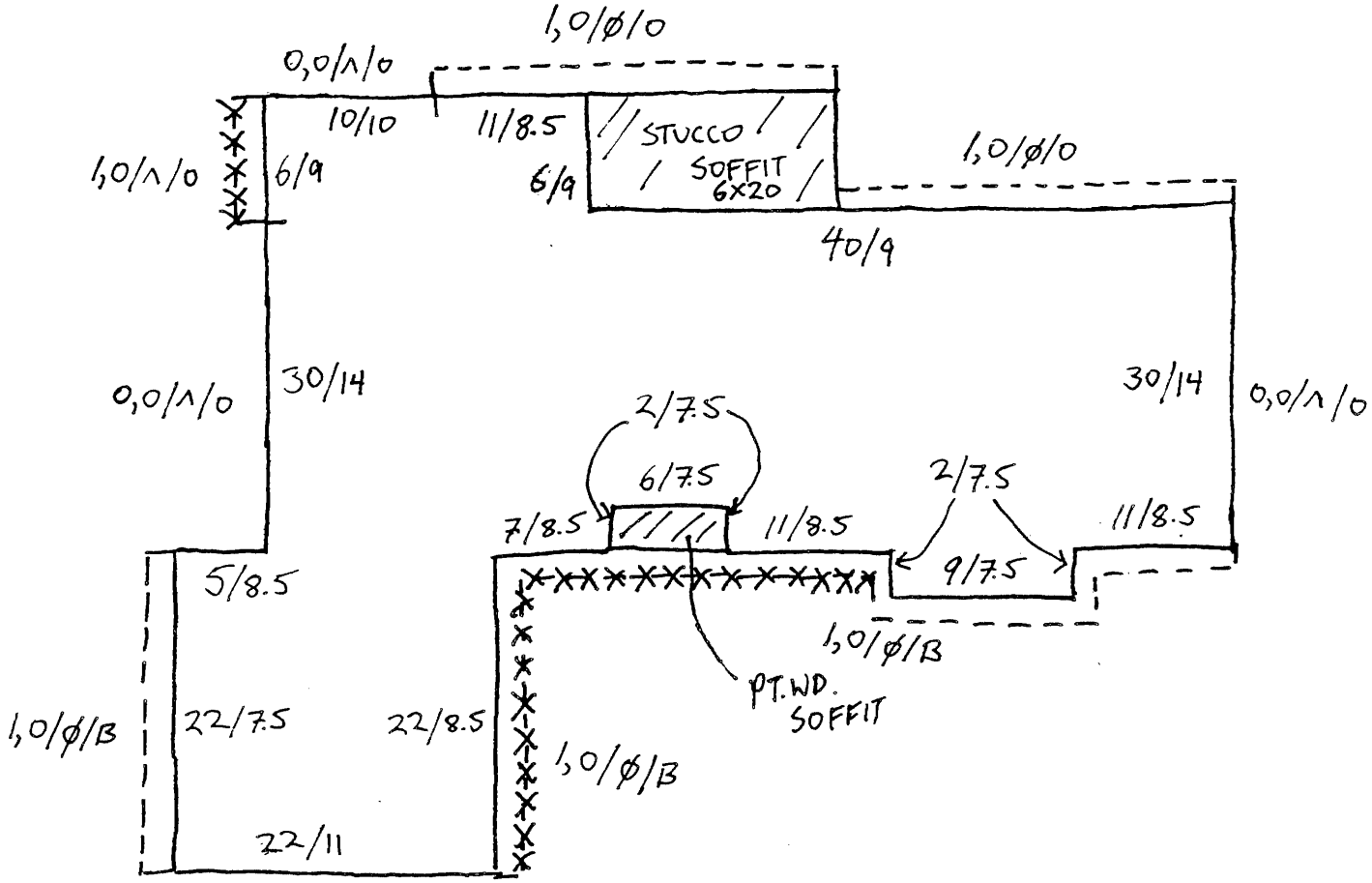
Finish (last digit)

1	Bare
2	Painted
3	Baked Painted
4	Varnish
5	Stained
6	Plastic/Vinyl
9	Unspecified

* Include various shingles and rolls made of composite materials containing asphalt.

Appendix C: Field Worksheet Example

STRUCTURE MAIN HOUSE SAMPLE NO. EXAMPLE



Roof: Mat.: WD SHINGLE Fin.: —

Eaves:
. soffit: Mat.: WD Fin.: Pt

. facing: Mat.: WD. Fin.: Pt

Gutters: Mat.: Al Fin.: Pt.

Wall: Mat.: Stucco Fin.: Pt.

Average Roof Pitch Angle: 18 °

SAMPLE NO. EXAMPLE

Item	Finish-Material Type	Dimensions (to nearest foot)			
		X	Y(d)	Z(n)	
CHIMNEY	B. BRICK	1.5	4	3	
ANTENNA	MED.				
A/C UNIT	P. GALV STEEL	3	4	2.5	DN

TYPE: 1 = Garage 2 = Solid
3 = Solid w/glass
4 = French 5 = Sliding glass

SAMPLE NO. EXAMPLE

No.	Type	Finish-Material Type					Dimension (to nearest inch)	
		Door	Casing	Screen				
				Frame	Screen	F	X	Y
1	5	P.AI	PW	BAI	F	0.5	142	81
2	5	P.AI	PW	BAI	F	0.5	70	84
1	3	PW	PW	BAI	F	1.0	35	83
1	3	PW	PW	—	—	—	35	83
1	1	PW	PW	—	—	—	192	84
1	2	PW	PW	—	—	—	36	82

SAMPLE NO. EXAMPLE

No.	Frame	Finish-Material Type				Dimensions (to nearest inch)	
		Screen			Bars		
		Frame	Screen	F		X	Y
2	PW	BAI	F	1.0	—	57	43
1	PW	—	—	—	—	62	62
1	PW	BAI	F	1.0	—	62	50
3	PW	—	—	—	—	39	25
2	PW	BAI	F	1.0	—	39	25
1	PW	—	—	—	—	54	35
3	PW	—	—	—	—	7	36
2	PW	—	—	—	—	63	26
1	PW	—	—	—	—	39	27
3	PW	—	—	—	—	26	56
1	BAI	BAI	F	0.5	—	28	39
1	PW	—	—	—	—	40	27

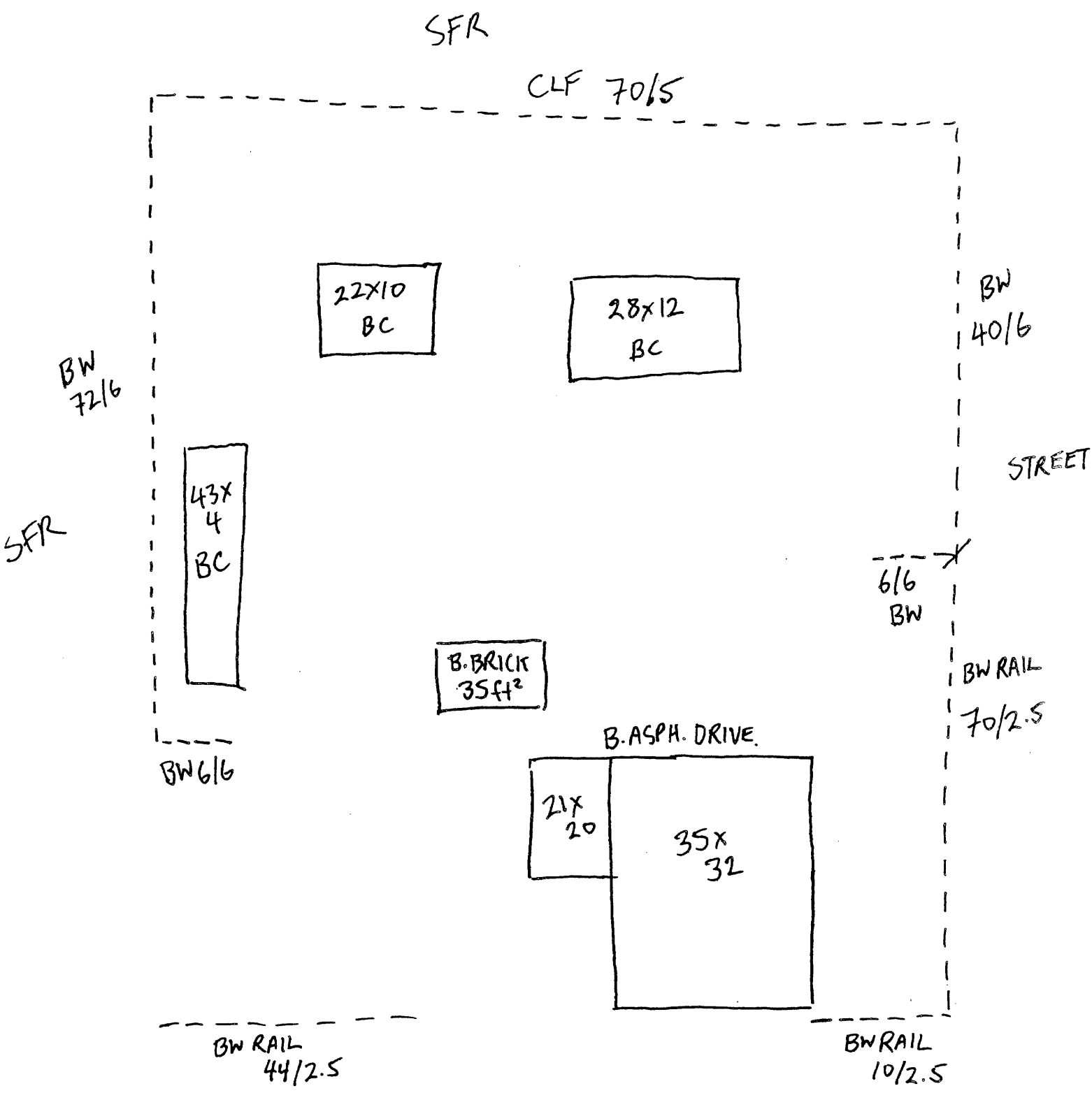
SAMPLE NO. EXAMPLE

Item	Finish-Material Type	Dimensions (to nearest unit)			
		X(in.)	Y(in.)	Z(in.)	Ft[a]
AWNING	P.A1				16 DNS
TRIM	B. BRICK				20
TRIM	B. BRICK				42
LITE FIX	1111				
FUSE BOX	P. STEEL	42	14		
TRIM	PW				6
TRIM	PW				4
DOWNSPOUTS	3 x 126"				
TRIM	PW				14
PATIO POSTS	PW				70

SAMPLE NO. EXAMPLE

Item	Finish-Material Type	Dimensions (to nearest foot)			
		X	Y(d)	Z	Ft²
STEP. STONES	STONE / CONC.				66
TRIM	B. BLOCK				35
SHED	P. AI	4.5	2	4.5	
TRIM	B. BRICK				63
LATTICE	PW				102
TRIM	B. BRICK				17
SAT. DISH	10' DIAMETER				

SAMPLE NO. EXAMPLE



Lot Size 70 X 120

Finish-Material	Factor	Finish-Material	Factor

Appendix D: Instructions for Field Worksheet

INSTRUCTIONS FOR FIELD WORK SHEETS

A. PARCEL SKETCH

1. Draw a sketch of the general horizontal outline of all permanent structures (e.g., main house, detached garage, apartment, etc.), all major land covering materials (e.g., driveways, pool, patios, etc.), and all fence lines. Note all structures and land covers by straight lines and all fence sections by dashed lines. Indicate the purpose of the land adjacent to the parcel boundaries (e.g., SFR, alley, street, NSFR, etc.).

2. Record the dimensions (to the nearest foot), material type, and finish of all major land coverings. Square the curves by estimating average distances. Estimate the remaining amount of material i, finish j as a percentage of major area measured. For example, if the driveway and patio were, say, 1,000 ft^2 of bare concrete, the bare concrete walkways might be estimated to be 20 percent of that total. Thus the total square footage of bare concrete would be (1.20)(1,000 ft^2) = 1,200 ft^2. Record such estimated adjustment factor (1.20 in the example) in the space provided.

3. For each fence section, record next to the fence its length, height (to the nearest foot in L/H format, e.g., 25/4), fence type (i.e., solid, picket, and rail), material type, and finish. Combination fences, such as block and wood, will likely require explanation on the back of the form.

B. STRUCTURE SKETCH

1. One form is to be completed for each major structure noted on the parcel sketch.

2. Draw a sketch of the general horizontal outline of the structure. Indicate wall lines by solid lines, roof lines by dashed lines, and gutters at roof line by Xs through the dashed lines where appropriate, i.e., "--**XXXXXXXXX**--".

3. For each wall section, record the length and <u>average</u> height of the wall next to its wall line. Measure to the nearest half foot and note in L/H format, e.g., 21.5/12.0.

4. Record for each eave section:

   a. the horizontal distance from the wall to the roof edge to the nearest half foot,

   b. the width of the facing to the nearest half foot,

   c. whether or not the section is on a "roof rise",

   d. soffit configuration by type.

Type S Type O Type B

Record this data outside the dashed roof line using this format:

horz., facing/ (= rise) or Ø (= not rise)/soffit type

e.g., 3.5, 1.0/ /S

5. Record the length of each gutter section to the nearest half foot. Use format GL (e.g., G10.5) next to the gutter section drawn.

6. Record the material and finish for eaves, gutters, roof, and predominate wall material in the space provided. However, more than one material/finish type will require making the appropriate notation on the drawing itself.

7. In accordance with the standard method, determine and record the average pitch angle of the roof.

C. ROOF ACCESSORIES

1. This table is for recording the finish, material type, and dimensions of the accessories found on the roofs of the major structures.

2. All details are to be estimated from ground level only. Dimensions are to be estimated to the nearest foot.

3. At a minimum, the following items are to be included when present in the dimensions shown. (Note: X, Y refers to the roof plane; whereas Z is the projecting dimension):

a. A/C and cooler units (X, Y, Z)

b. skylights (X, Y)

c. chimney above roof line (X, Y, Z)

d. solar panels (X, Y, Z)

e. antenna, by type and size, i.e., S=small, M=medium, or L=large according to photo standard (n, number)

f. satellite dish (d, i.e., diameter of dish)

g. rotary roof vents (n, number)

4. The first line preceeding the accessories on a common roof is to be the structure name, e.g., main house, detached garage, etc. Two blank lines are to be left before the next "structure" entry.

D. WALL DATA

1. General

   a. Start at any wall section and go clockwise around the structure. Except for "clear" wall sections, every section should have a data entry in one of the three wall data tables, i.e., "Doors", "Windows", and "Wall Accessories".

   b. Fully complete each wall section before moving to the next one.

2. Doors

   a. "No." means the number of doors with the characteristics recorded. Remember that a double door counts as one with the dimensions encompassing both "doors".

   b. Except for "F", record the finish and material type for items indicated.

   c. "F" means the fraction of the door covered by the screen (usually 1.0 or 0.5). Record zero if not present.

   d. Measure all doors to the edge of the door casing to the nearest inch. Casings tend to be one inch wide. The dimensions of the door would thus be X-1 inch and Y-1 inch.

   e. The first line preceeding the doors on a common structure is to be the structure name. Two blank lines are to be left before the next "structure" entry.

3. Windows

   Similar to instructions for doors.

4. Wall Accessories

   a. This table is to include all other wall items, which include:

      - o Trim - to include all ornamental items such as trim around doors and windows and wall brick work.
      - o Chimney - to include chimney material to roof line.
      - o Downspouts
      - o All "3-D" items such as roof supports, windows, A/C or cooler units, and so on.

   b. Measure all dimensions to the nearest inch. However, for small irregular shapes, estimate to the nearest one half square foot (Note: X, Y refers to wall plane; whereas Z is the projecting dimension).

   c. The first line preceeding the wall accesories on a common structure is to be the structure name. Two blanks lines are to be left before the next "structure" entry.

E. NON-STRUCTURE ACCESSORIES

1. Measure the following items to the nearest foot in dimensions noted:

a. Sheds (X, Y, Z)

b. A/C or cooler unit (X, Y, Z)

c. Gazebos (X, Y, Z or d, Z)

d. Satellite dish (dish diameter, d)

2. For each patio and carport, note roof and frame material separately. Estimate total square feet of each based on rough measurments.

Appendix E: Conventions for Field Data Reduction

CONVENTIONS FOR FIELD DATA REDUCTION

(All calculated values in sq. ft.)

EAVES:

SOFFIT:

Type: S = Length x Width (x Roof factor if the eave is rising)
O = Length x Width x 2
B = Length x Width (x Roof factor if the eave is rising)

FACING:

If flashing present:
Length x Facing Width x 1.76 (x Roof factor if the eave is rising)
If flashing not present:
Length x Facing Width x 2.00 (x Roof factor if the eave is rising)

FLASHING:

Facing Length x 0.12 ft (x Roof factor if the eave is rising)

GUTTERS:

If painted:
Length x 0.75 ft. (Bare portion)
Length x 0.50 ft. (Painted portion)
If bare:
Length x 1.25 ft.

DOWNSPOUTS

Length x 0.83 ft.

FENCES:

WOOD RAIL:

Surface Area = Length x (Height/3 + 2.4 ft.)

WROUGHT IRON:

Surface Area = Length x (Height x 0.4 + 0.67 ft.)

SOLID WOOD:

Surface Area = Length x Height x 2.2

PICKET WOOD:

Surface Area = Length x Height x 2

CHAIN LINK and other mesh types:

Surface Area = Length x Height

---

*Type S = Smooth eave under-face, Type O = Open beam on eave under-face, and Type B = Boxed-in eave.

Roof factor is given by an inverse of cos where is the slope of the roof (e.g., = 0 for flat roof).

DOORS AND WINDOWS:

Only dimensions measured in field were length, X, and width, Y, in inches. Inset values and materials distributions were calculated as follows: (All equations include conversion from inches to feet)

WOOD DOOR:	Door	= (X-2)(Y-2)/144
	Casing	= 6(X+Y)/144
DOOR W/GLASS:	Door	= (X-2)(Y-2)/192
	Glass	= (X-2)(Y-2)/576
	Casing	= 6(X+Y)/144
FRENCH DOOR:	Door	= (X-2)(Y-2)/288
	Glass	= (X-2)(Y-2)/288
	Casing	= 6(X+Y)/144
SLIDING GLASS DOOR:	Door	= (X/36)+(Y/24)
	Glass	= (X-6)(Y-6)/144
	Casing	= (X+Y)/24
WOOD WINDOW:	Casing	= (X+Y)/12
	Glass	= (X-8)(Y-8)/144
AL. WINDOW:	Casing	= (X+Y)/24
	Glass	= (X-2)(Y-2)/144
STEEL WINDOW:	Casing	= (X+Y)/18
	Glass	= (X-4)(Y-4)/144
WINDOW SCREEN MESH		= XY/144 *(Screen Coverage Factor)
WINDOW SCREEN FRAME		= 2(X+Y-4)/144
DOOR SCREEN MESH		= (X-2)(Y-2)/144
WOOD DOOR SCREEN FRAME		= (18Y+52X)/144
AL. DOOR SCREEN FRAME		= (10Y+40X)/144
STEEL SECURITY SCREEN		= [(20Y + 9X+(X-2)(Y-2))/144 + 1
SLIDING GLASS DOOR SCREEN FRAME		= (8X+8Y)/144
WOOD SLIDING SCREEN DOOR FRAME		= (12X+12Y)/144

REFERENCE CHART FOR FIELD DATA ENTRY

ITEM	INCLUDED
Tot Grnd Area	Main structures' footprint area
Tot Roof Area	Roof area excluding features and accessories
Tot R Feat Ar	Facing, Flashing, Chimneys, and Gutters
No Roof Acc	1 - Climatic Unit; 2 - Skylight; 3 - Solar Panels; 4 - Roof Vent; 5 - TV Antenna.
Tot Bs Wall Ar	Actual wall area (exclude windows, etc.)
Tot Prm Win Ar	Frame and glass area
Tot Sec Win Ar	Screens, Security Bars, and Awnings
Tot Prm Dr Ar	Casing, door, and glass area
Tot Sec Dr Ar	Screen Doors and Security Doors
Tot Wl Att Ar	Downspouts, Attached Sheds, and Water Heater Casings
No Wall Acc	Climatic Units on Walls and Light Fixtures
Tot Soffit Ar	Eaves and Underneath Surfaces
Tot Min Str Ar	Patios, Carports, Gazebos, and Sheds
Tot Grnd Cv Ar	Non-Structure ground cover (exclude sidewalk)
No Grnd Acc	Climatic Units, Satellite Dishes, and Pool Heaters

Appendix F: Field Survey Coding Sheet

FIELD SURVEY CODING SHEET

	ITEM	COLUMN SPACE
1.	VRC I.D. Number	4
2.	Location I.D. (1. LA, 2. OR, 3. RV, 4. SB followed by TBM Page No.)	4
3.	Reported Livable Space	4
4.	Measured Livable Space	4
5.	Total Ground Area with Building	4
6.	Number of Buildings	1
7.	Number of Stories	1
8.	Total Roof Area (Exclude roof features and accessories)	4
9.	Numbers of Material-finish combinations for roof	1
	9.1 First Material, finish and area	2-1-4
	9.2 Second Material, finish and area	2-1-4
	9.3 Third material, finish, and area	2-1-4
10.	Total Area of Roof Features (i.e., chimney and gutters)	3
11.	Number of Material-finish Combinations for Roof Features	1
	11.1 First material, finish, and area	2-1-2
	11.2 Second material, finish, and area	2-1-2
	11.3 Third material, finish, and area	2-1-2
	11.4 Fourth material, finish and area	2-1-2
	11.5 Fifth material, finish and area	2-1-2
12.	Number of Roof Accessory Types (1. Climatic unit, 2. Skylight, 3. Solar panel, 4. Roof vent, 5. TV antenna)	1
	12.1 First accessory type, size class, and number	2-1-1
	12.2 Second accessory type, size class, and number	2-1-1
	12.3 Third accessory type, size class, and number	2-1-1
	12.4 Fourth accessory type, size class, and number	2-1-1
	12.5 Fifth accessory type, size class, and number	2-1-1
	12.6 Sixth accessory type, size class, and number	2-1-1
	12.7 Seventh accessory type, size class, and number	2-1-1
13.	Total Basic Wall Area (Exclude windows, doors, attachments, and accessories)	4

ITEM		COLUMN SPACE
14.	Number of Material-finish Combinations for Basic Wall	1
	14.1 First Material, finish, and area	2-1-4
	14.2 Second Material, finish, and area	2-1-4
	14.3 Third Material, finish, and area	2-1-4
	14.4 Fourth Material, finish, and area	2-1-4
	14.5 Fifth Material, finish, and area	2-1-4
15.	Total Primary Window Area (Exclude screens, security bars and AC's)	3
16.	Number of Material-finish Combinations for Primary Window Surface	1
	16.1 First Material, finish and area	2-1-3
	16.2 Second Material, finish and area	2-1-3
	16.3 Third Material, finish and area	2-1-3
	16.4 Fourth Material, finish and area	2-1-3
	16.5 Fifth Material, finish and area	2-1-3
17.	Total Secondary Window Area (i.e., screens, security bars, and window awning.)	3
18.	Number of Material finish Combinations for Secondary Window Surface	1
	18.1 First material, finish, and area	2-1-3
	18.2 Second material, finish, and area	2-1-3
	18.3 Third material, finish, and area	2-1-3
	18.4 Fourth material, finish, and area	2-1-3
	18.5 Fifth material, finish, and area	2-1-3
19.	Total Primary Door Area (Exclude screen doors and security bars)	3
20.	Number of Material-finish Combinations for Primary Door Surface	1
	20.1 First Material, finish, and area	2-1-3
	20.2 Second Material, finish, and area	2-1-3
	20.3 Third Material, finish, and area	2-1-3
	20.4 Fourth Material, finish, and area	2-1-3
	20.5 Fifth Material, finish, and area	2-1-3
21.	Total Secondary Door Area (i.e., screen doors and security bars)	3
22.	Number of Material-finish Combinations for Secondary Door Surface	1
	22.1 First Material, finish, and area	2-1-3
	22.2 Second Material, finish, and area	2-1-3
	22.3 Third Material, finish, and area	2-1-3
	22.4 Fourth Material, finish, and area	2-1-3
	22.5 Fifth Material, finish, and area	2-1-3

	ITEM	COLUMN SPACE
23.	Total Wall Attachment Area (i.e., anything attached to wall except for accessories, e.g., downspouts, attached garden sheds and water heater casing)	3
24.	Number of Material-finish Combinations for Wall Attachments	1
24.1	First Material, finish, and area	2-1-3
24.2	Second Material, finish, and area	2-1-3
24.3	Third Material, finish, and area	2-1-3
24.4	Fourth Material, finish, and area	2-1-3
24.5	Fifth Material, finish, and area	2-1-3
25.	Number of Wall Accessory Types (e.g., climatic units, light fixtures, etc.)	1
25.1	First Accessory Type, size class, and number	2-1-1
25.2	Second Accessory Type, size class, and number	2-1-1
25.3	Third Accessory Type, size class, and number	2-1-1
26.	Total Soffit Area (e.g., eves and underneath surfaces)	3
27.	Number of Material-finish Combinations of Soffit	1
27.1	First Material, finish and area	2-1-3
27.2	Second Material, finish and area	2-1-3
27.3	Third Material, finish and area	2-1-3
28.	Total Minor Structure Area (e.g., patios, carports, gazebos and sheds)	3
29.	Number of Material-finish Combinations for Minor Structures	1
29.1	First Material, finish, and area	2-1-3
29.2	Second Material, finish, and area	2-1-3
29.3	Third Material, finish, and area	2-1-3
29.4	Fourth Material, finish, and area	2-1-3
29.5	Fifth Material, finish, and area	2-1-3
30.	Total Ground Cover Area (e.g., walkway, flower bed, and garage pavement, but exclude sidewalk)	4
31.	Number of Material-finish Combinations for Ground Cover	1
31.1	First Material, finish and area	2-1-4
31.2	Second Material, finish and area	2-1-4
31.3	Third Material, finish and area	2-1-4
31.4	Fourth Material, finish and area	2-1-4
31.5	Fifth Material, finish and area	2-1-4
31.6	Sixth Material, finish and area	2-1-4

ITEM		COLUMN SPACE
32.	Number of Ground Accessories (e.g., climatic units, satelite dishes, pool heaters, etc.).	1
32.1	First Accessory Type, size, class, and number	2-1-1
32.2	Second Accessory Type, size, class, and number	2-1-1
32.3	Third Accessory Type, size, class, and number	2-1-1
32.4	Fourth Accessory Type, size, class, and number	2-1-1
32.5	Fifth Accessory Type, size, class, and number	2-1-1
33.	Total Fence Area	4
34.	Number of Material-finish Combinations for Fences	1
34.1	First Material, finish, and area	2-1-4
34.2	Second Material, finish, and area	2-1-4
34.3	Third Material, finish, and area	2-1-4
34.4	Fourth Material, finish, and area	2-1-4
34.5	Fifth Material, finish, and area	2-1-4

Appendix G: Material Factors for Enumeration Items

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
BARE METAL STREET LIGHT	49.5: SUPPORTING COLUMN 3.1: EXTENSION ARM 7.1: LIGHT FIXTURE 3.0: STREET SIGN	0.8: GLASS 52.6: GAL. STEEL 6.3: B. ALUMINUM 3.0: PT. STEEL 62.7: TOTAL AREA
PT. METAL STREET LIGHT	49.5: SUPPORTING COLUMN 3.1: EXTENSION ARM 7.1: LIGHT FIXTURE 3.0: STREET SIGN	0.8: GLASS 3.1: GAL. STEEL 6.3: B. ALUMINUM 52.5: PT. STEEL 62.7: TOTAL AREA
CONCRETE STREET LIGHT	45.8: SUPPORTING COLUMN 3.1: ARM 7.1: LIGHT FIXTURE 3.0: STREET SIGN	45.8: CONCRETE 0.8: GLASS 3.1: GAL. STEEL 6.3: BARE ALUMINUM 3.0: PT. STEEL 59.0: TOTAL AREA
ARM ONLY STREET LIGHT	18.8: ARM 7.1: LIGHT FIXTURE	0.8: GLASS 18.8: GAL. STEEL 6.3: BARE ALUMINUM 25.9: TOTAL AREA
BARE METAL POST	7.3: METAL POLE 6.2: STREET SIGN	7.3: GAL. STEEL 6.2: PT. METAL 13.5: TOTAL AREA
PT. METAL POST	7.3: METAL POLE 6.2: STREET SIGN	7.3: PT. GAL. STEEL 6.2: PT. METAL 13.5: TOTAL AREA
GRATED METAL POST-- BARE	6.3: METAL POLE 4.5: STREET SIGN	6.3: GAL. STEEL 4.5: PT. METAL 10.8: TOTAL AREA
GRATED METAL POST-- PAINTED	6.3: METAL POLE 4.5: STREET SIGN	6.3: PT. GAL. STEEL 4.5: PT. METAL 10.8: TOTAL AREA

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
PAINTED WOOD POSTS	9.5: WOOD POLE 7.0: STREET SIGN	9.5: PT. WOOD 7.0: PT. METAL 16.5: TOTAL AREA
BARE WOOD POSTS	9.5: WOOD POLE 7.0: STREET SIGN	9.5: BARE WOOD 7.0: PT. METAL 16.5: TOTAL AREA
MAILBOX	25.5: MAIN BODY	25.5: PT. METAL 25.5: TOTAL AREA
HYDRANT	9.4: MAIN BODY	9.4: PT. METAL 9.4: TOTAL AREA
SIDEWALK	CROSS SECTION OF 5.3 sq. ft. PER LINEAR FOOT. (5.3)x(length) : TOTAL AREA	
CURB	CROSS SECTION OF 1.1 sq. ft. PER LINEAR FOOT. (1.1)x(length) : TOTAL AREA	
METAL GUARDRAIL	CROSS SECTION OF 2.7 ft. OF METAL GUARD-RAIL. WOODEN POSTS HAVE 9.3 sq. ft. OF AREA FOR EVERY 8 ft. OF METAL GUARDRAIL. (2.7)x(LENGTH) : TOTAL METAL AREA (9.3)x(LENGTH/8) : TOTAL WOOD AREA	
CONCRETE GUARDRAIL	CROSS SECTION OF 4.0 ft. OF CONCRETE GUARD-RAIL. (2.7)x(LENGTH) : TOTAL CONCRETE AREA	

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
STOP LIGHT: OVERHANG - PAINTED	53.4: GAL. STEEL SUPPORT	2.6: GLASS
	10.2: ARM AND LIGHT FIX-TURE OF SUPPORTING STREET LIGHT	62.8: PT. GAL. STEEL
		64.6: PAINTED METAL
	21.1: STOP LIGHT FIXTURE	
	25.1: STOP LIGHT ARM	
	20.2: STREET SIGN	
		130.0: TOTAL AREA
STOP LIGHT: OVERHANG - BARE	53.4: GAL. STEEL SUPPORT	2.6: GLASS
	10.2: ARM AND LIGHT FIX-TURE OF SUPPORTING STREET LIGHT	62.8: GAL. STEEL
		64.6: PAINTED METAL
	21.1: STOP LIGHT FIXTURE	
	25.1: STOP LIGHT ARM	
	20.2: STREET SIGN	
		130.0: TOTAL AREA
STOP LIGHT: UPRIGHT - PAINTED	14.3: GAL. STEEL SUPPORT	39.3: PAINTED METAL
	21.1: STOP LIGHT FIXTURE	16.7: PT. GAL. STEEL
	10.9: CROSS-WALK SIGN	0.9: PLASTIC
	14.2: STREET SIGN	3.6: GLASS
		60.5: TOTAL AREA
STOP LIGHT: UPRIGHT - BARE	14.3: GAL. STEEL SUPPORT	39.3: PAINTED METAL
	21.1: STOP LIGHT FIXTURE	16.7: GAL. STEEL
	10.9: CROSS-WALK SIGN	0.9: PLASTIC
	14.2: STREET SIGN	3.6: GLASS
		60.5: TOTAL AREA
TRANS-MISSION TOWER:	1800: MAIN SUPPORT BODY	2240: GAL. STEEL
	440: SIDE SUPPORTS	
	6 LARGE CERAMIC INSULATORS	
		2240: TOTAL AREA

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
DISTRIBUTION POLE (74%-0 TRANS. 15%-1 TRANS. 8%-2 TRANS. 3%-3 TRANS.)	180: MAIN POLE BODY 5.3: CROSS SUPPORTS MEDIUM AND SMALL INSULATORS 185.3: TOTAL AREA	180: CREOSOTE WOOD 5.3: GAL. STEEL
TRANSFORMER	28.3: MAIN BODY 6.8: METAL SUPPORTS 2 SMALL CERAMIC INSULATORS 35.1: TOTAL AREA	28.3: PT. STEEL 6.8: GAL. STEEL
RAILROAD BRIDGE	11200: I-BEAM SUPPORTS 560: RIGHT ANGLE SUPS. 3240: CONCRETE RETAINER 15000: TOTAL AREA	11760: PT. STEEL 3240: CONCRETE
RAILROAD TRACK	CROSS SECTION OF 4 sq. ft. PER LINEAR FOOT OF TRACK OF BARE STEEL. (4.0)x(LENGTH): TOTAL AREA	
WOOD TRANS-MISSION POLE	175: MAIN POLE 60: UNDER SUPPORTS 32: CROSS BEAMS 11: CROSS BEAM SUPPORT 6: METAL ATTACHMENTS 9 MEDIUM CERAMIC INSULATORS 284: TOTAL AREA	267: CREOSOTE WOOD 17: GAL. STEEL
SMALL FLOOD CONTROL CHANNEL	CROSS SECTION OF 50 sq. ft. OF BARE CONCRETE AND 18 sq. ft. OF APPARENT CHAIN LINK FENCE PER LINEAR FOOT. (50)x(LENGTH): TOTAL CONCRETE (18)x(LENGTH): CHAIN LINK	
LARGE FLOOD CONTROL CHANNEL	CROSS SECTION OF 100 sq. ft. OF BARE CONCRETE AND 18 sq. ft. OF APPARENT CHAIN LINK FENCE PER LINEAR FOOT. (100)x(LENGTH): TOTAL CONCRETE (18)x(LENGTH): CHAIN LINK	

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
EVAP-ORATIVE COOLER	51.8: MAIN BODY	51.8: PT. STEEL 51.8: TOTAL AREA
ROOF AND GROUND A/C	43.6: MAIN BODY	43.6: PT. STEEL 43.6: TOTAL AREA
WALL A/C	13.7: MAIN BODY	13.7: PT. STEEL 13.7: TOTAL AREA
SKYLIGHT	10.0: OPAQUE BODY	10.0: PLASTIC 10.0: TOTAL AREA
SOLAR PANEL	24.0: TOP COVER 3.4: PIPING 30.0: MAIN BODY	24.0: PLASTIC 3.4: COPPER 30.0: PT. STEEL 57.4: TOTAL AREA
CIRCULAR ROOF VENT	5.11: MAIN BODY	5.11: GAL. STEEL 5.11: TOTAL AREA
SATELLITE DISH	28.3: DISH UPPER AREA 28.3: DISH LOWER AREA 4.7: DISH SUPPORT	56.6: PT. ALUMINUM 4.7: PT. STEEL 61.3: TOTAL AREA
LIGHT FIXTURE	1.20: MAIN BODY	1.0: GLASS 0.2: PT. STEEL 1.20: TOTAL AREA
POOL PLUMBING	32.0: MAIN BODY 19.0: FILTER 2.0: PUMP 4.6: PIPING	53.0: PT. STEEL 4.6: COPPER 57.6: TOTAL AREA

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
TV ANTENNA LARGE	5.2: SUPPORT POLE 1.6: CROSS SUPPORT 1.6: CROSS PRONGS	5.2: GAL. STEEL 3.2: B. ALUMINUM 8.4: TOTAL AREA
TV ANTENNA MEDIUM	2.6: SUPPORT POLE 1.6: CROSS SUPPORT 1.6: CROSS PRONGS	2.6: GAL. STEEL 3.2: B. ALUMINUM 5.8: TOTAL AREA
TV ANTENNA SMALL	1.0: SUPPORT POLE 0.7: CROSS SUPPORT 0.1: CROSS PRONGS	1.0: GAL. STEEL 0.8: B. ALUMINUM 1.8: TOTAL AREA
SIGN-NSFR	215.0: MAIN BODY	172.0: B. PLASTIC 11.0: PT. WOOD 32.0: PT. METAL 215.0: TOTAL AREA
TANK	258.0: MAIN BODY	258.0: PT. METAL 258.0: TOTAL AREA
SHED	43.0: MAIN BODY	32.0: PT. METAL 11.0: PT. WOOD 43.0: TOTAL AREA
SHOULDER REFLECTOR	2.9: MAIN BODY 1.0: REFLECTOR PLATE	3.4: B. GAL. STEEL 0.5: PT. METAL 3.9: TOTAL AREA
RAILROAD CROSSING	14.3: GAL. STEEL SUPPORT 21.1: LIGHT FIXTURE 10.9: RR CROSSING SIGN 22.0: CROSSING BAR	28.4: PAINTED METAL 14.3: GAL. STEEL 3.6: GLASS 22.0: PT. WOOD 68.3: TOTAL AREA

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
TWO POST SIGN -- FREEWAY	188: MAIN POST 360: LATTICE SUPPORT 384: SIGN	548: BARE METAL 384: PT. METAL
		932: TOTAL AREA
ONE POST SIGN -- FREEWAY	94: MAIN POST 100: LATTICE SUPPORT 128: SIGN	194: BARE METAL 128: PT. METAL
		322: TOTAL AREA
SIGN ATTACHED TO BRIDGE	114: SIGN	114: PT. METAL
		114: TOTAL AREA
FREEWAY INTER-CHANGE T TYPE	93600: MAIN BODY 20300: BODY SUPPORT 7400: RAILING	113900: BARE CONCRETE 7400: B. GAL. STEEL
		121300: TOTAL AREA
FREEWAY INTER-CHANGE Y TYPE	62400: MAIN BODY 13500: BODY SUPPORT 4400: RAILING	75900: BARE CONCRETE 4400: B. GAL. STEEL
		80300: TOTAL AREA
FREEWAY INTER-CHANGE X TYPE	187000: MAIN BODY 40600: BODY SUPPORT 15600: RAILING	227600: BARE CONCRETE 15600: B. GAL. STEEL
		243200: TOTAL AREA
OVER/ UNDER PASS	14550: MAIN BODY 1280: RAILING	14550: BARE CONCRETE 1280: B. GAL. STEEL
		15830: TOTAL AREA
CHAIN LINK FENCE	CROSS SECTION OF 6 sq. ft. PER LINEAR FOOT	6.0 X (LENGTH): TOTAL AREA

ITEM	SQ.FOOTAGE BY ELEMENT	SQ.FOOTAGE BY MATERIAL
ON/OFF RAMP SIGNS	27.1: SIGN 15.5: POSTS	27.1: PT. METAL 15.5: BARE WOOD
		42.6: TOTAL AREA

Appendix H: General Instructions for NSFR Parcel File and Revisions

GENERAL INSTRUCTIONS FOR THE DEVELOPMENT OF THE NSFR PARCEL FILE FOR ARB CONTRACT A6-079-32

November 23, 1987

Prepared for:

Dr. Richard Ellefsen
San Jose State University

Prepared by:

Dr. Yuji Horie
Arthur Shrope
Valley Research Corporation
(818) 902-0022

I. PROTOCOLS FOR DEVELOPING NSFR PARCEL FILE

A. GENERAL

This document outlines the framework in which SJSU is to work while developing the NSFR Parcel File. Basically,

- o SJSU is to use its judgment and expertise in remote sensing techniques to photo analyze the VRC selected mapbooks as noted in the project interim report; and
- o In doing the work, SJSU is to follow the protocols and data delivery format as specified herein.

Strict adherence to these specifications is required in order for the SJSU work to properly dovetail into VRC's project scheme. However, if problems arise that require a change to these specifications, SJSU must consult VRC for such change before work proceeds.

B. SPECIFIC PROTOCOLS

1. Every parcel selected by VRC for SJSU photo analysis must be described by a single record or line in this file.
2. The file is to reflect the situation as it existed around July 1986, the date of assessor files that VRC is working with. Therefore, analysis is to be done from those vertical photos provided by Air Photo Services through VRC, which are circa late spring 1986.
3. The low attitude oblique photographs can be used to determine the number of stores in the building identified in the Air Photo Services photos. All other new buildings noted in the obliques are to be ignored, i.e., no mention of them are to be made in the NSFR Parcel File.

II. CODING INSTRUCTIONS FOR NSFR PARCEL FILE DATA SHEET

A. GENERAL

1. As noted in Figure 1, the variables are organized in fixed-column format. All entries must be composed of right justified, contiguous numerical characters; entries may not contain internal blanks, but may contain leading blanks, i.e., left zeros are not needed.
2. Except for special cases related to clusters, no data field is to be left blank. If the item called for in a particular field is not observed in the parcel, record a right justified "0" for not present.
3. In general, all values are to be based on actual photo measurements rather than by some arithmetic method.
4. To help avoid ambiguities in the coding please:
   - use ink or dark pencil,
   - write 7 for numerical seven, and
   - ask questions until you are crystal clear about what and how to record data in this sheet.

B. SPECIFIC INSTRUCTIONS

1. ANALYST NAME

   The person's name who did the analysis and data recording for the parcels noted in the sheet.

2. PHONE NUMBER

   A phone number for the analyst.

3. PARCEL ID NUMBER

   The full county assessor parcel ID number.

4. VRC USE CODE

   Record the use code that VRC has assigned to the parcel (see Table 1 for list of codes).

5. FUNC. CODE

   Record the SJSU function code that best describes the parcel (see Table 2 for list of codes).

6. CONST. CODE

   Record the SJSU construction code that best describes the buildings found on the parcel (see Table 2 for list of codes).

NSFR PARCEL FILE DATA SHEET

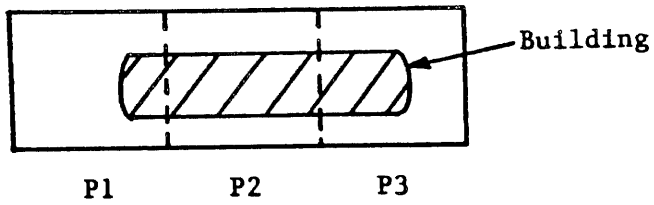
Analyst Name: Phone No.: ( ) VRC-1058-DS-1

Parcel ID No.	VRC Use Code	Func. Code	Const. Code	Cluster (x of n)	Land Area Data At Ground Level (all in sq. meters)						Building Data			
					Parcel Total (m^2)	Building Total (m^2)	Concrete Total (m^2)	Asphalt Total (m^2)	Bare Total (m^2)	Other Total (m^2)	Total No. Bldgs. (xx.x)	Height: Tallest Bldg. (meters)	Height: Avg. Bldg. (meters)	Total Bldg. Floor Area (m^2)
1 2 3 4 5 6 7 8 9 10	11 12	13	14	15 16	17 18 19 20 21 22 23	24 25 26 27 28 29	30 31 32 33 34 35	36 37 38 39 40 41	42 43 44 45 46 47 48	49 50 51 52 53 54	55 56 57	58 59 60	61 62 63	64 65 66 67 68 69 70 71 72 73

Figure 1. NSFR Parcel File Data Sheet

7. CLUSTER

a. Purpose - The cluster concept provides a way to handle contiguous parcels that share a building. To fix matters, consider this situation:



As shown here, the cluster is defined by the outside boundary of the three parcel continuum that holds the building. The cluster now becomes the "parcel" of interest.

Observe that clusters can range from a single parcel to as many as it takes to hold a building.

b. Coding Instructions - Continuing with the 3-parcel cluster example:

(1) Do the analysis on the 3-parcel cluster as if it were a single parcel.

(2) Divide the value called for by the data field by the number of cluster parcels, which is 3 in the example.

NOTE: the data field "No. Stories" is to be left intact, i.e., not divided.

(3) For the first parcel in the cluster sequence, generate a line entry by:

(a) Enter "13" in the "cluster" field to signify that this line is for the first parcel in a cluster of 3. (This would be "11" for 1-parcel "cluster".)

(b) Complete the rest of the line by entering the equal proportional amount for each item, 1/3 of each in this example. Again, remember that data field "No. Stories" is just that for the cluster without division.

(4) Complete lines for the remaining cluster parcels, stopping at the "cluster" field. Here, enter "23" for the second parcel record and "33" for the third parcel. The balance of the lines are to remain blank.

8. LAND AREA DATA AT GROUND LEVEL

These six data fields fully characterize the parcel (or cluster) at ground level by asking for:

- Total square meters of the parcel; and
- Total square meters of land covered by buildings, concrete, asphalt, bare (e.g., dirt fields, landscaping, etc.), and all other not specifically classified here.

All six values must be based on actual photo measurements, and not on some arithmetic technique such as back calculating to the parcel total.

Except for "Parcel Total" and "Building Total" where measurement is to be to the square meter, do one of the following for each field.

- If $x > 64$ m², record actual value,
- If $64 \text{ m}^2 \geq x > 16 \text{ m}^2$, record "2",
- If $16 \text{ m}^2 \geq x > 0 \text{ m}^2$, record "1", or
- If not observed or present, record "0".

9. BUILDING DATA

a. Total No. Bldgs - Total number of buildings recorded to the nearest tenth of a building. For example, two buildings on a single parcel would be recorded as "20"; whereas if on a n-parcel cluster where, say, n equals 3, this entry would read "7" for 0.7 (=2/3).

b. Height - This field accounts for the two data items noted below. Unlike the other data items that are divided by n when an n-parcel cluster is encountered, these are recorded as found without division.

(1) Tallest Bldg. - The height in meters of the tallest building in the parcel or cluster.

(2) Avg. Bldg. - Average height in meters of all buildings found in the parcel or cluster.

c. Total Bldg. Floor Area - Here, the actual estimated floor space for each building is summed over all building in the parcel. Remember that for n-parcel clusters, this entry equals cluster total divided by n for the first parcel record.

TABLE 1. LIST OF VRC USE CODES

CODE	CODE NAME	EXPLANATION
LOS ANGELES COUNTY		
10	SMFR	Small multi-family residential
11	LMFR	Large MFR
12	RCNDO	Residential condominium
13	SNR	Small non-residential
14	LNR	Large NR
15	MJR 1	Major Property - Class 1
16	MJR 2	Major Property - Class 2
17	MJR 3	Major Property - Class 3
18	VAC	Vacant parcel
19	UNK	Unknown or unclassifiable
ORANGE COUNTY		
20	MFR	Multi-family residential
22	RCNDO	Residential condominium
23	IND	Industrial parcel
24	COM	Commercial parcel
25	EXP	Assessment exempt (e.g., government owned)
26	MH	Mobile homes
27	AGR	Agricultural type parcel
28	VAC	Vacant parcel
29	UNK	Unknown or unclassifiable
RIVERSIDE COUNTY		
30	MFR	Multi-family residential
32	RCNDO	Residential condominium
33	NR	Non-residential
36	MH	Mobile homes
37	AGR	Agricultural type
38	VAC	Vacant parcel
39	UNK	Unknown or unclassifiable
SAN BERNARDINO COUNTY		
40	MFR	Multi-family residential
41	NRCNDO	Non-residential condominium e.g., medical/dental office condos)
42	RCNDO	Residential condominium
43	NR	Non-residential
45	GOVT	Government owned parcel
46	MH	Mobile homes
47	AGR	Agricultural type parcel
48	VAC	Vacant parcel
49	UNK	Unknown or unclassifiable

TABLE 2. LIST OF SJSU CODES

TYPE/CODE	EXPLANATION
FUNCTION	
1	Multi-family
2	Commercial
3	Industrial
4	Administrative/Cultural
5	Parking
6	Vacant
7	Other, e.g., "city owned"
CONSTRUCTION	
1	Unit masonry
2	Concrete
3	Wooden post and lintel
4	Steel reinforced concrete frame

VALLEY RESEARCH CORPORATION

15904 STRATHERN STREET, SUITE 20, VAN NUYS, CALIFORNIA 91406 (818) 902-0022

February 5, 1988

Richard Ellefsen, Ph. D.
Department of Geography
San Jose State University
One Washington Square
San Jose, California 95192

Dear Richard,

This letter is to confirm our understanding of the changes to the NSFR Parcel File that we agreed to during our conversation on the third and today. The agreement has two facets: reduce the number of parcels to be evaluated by SJSU, and streamline the encoding procedures. Specifically, these are:

SAMPLE SIZE

Based on our agreement with ARB, SJSU is to now include the following types of parcels:

a. For the Los Angeles County mapbooks, include all parcels noted as major properties by VRC use codes:

Code	Code Name	Explanation
15	MJR 1	Major Property - Class 1
16	MJR 2	Major Property - Class 2
17	MJR 3	Major Property - Class 3

b. All parcels found to be part of clusters are to be included, regardless of county. This is understood to include clusters as defined in "General Instructions for Development of the NSFR Parcel File for ARB Contract A6-07932", November 1987, and all "air projects" such as residential and non-residential condominiums.

c. For all remaining parcels, i.e., "single" parcels, evaluate only those whose parcel I.D. number ends with an odd number.

ENCODING CHANGES

1. SJSU will encode all parcel data into Microsoft "Multi-Plan Spreadsheet" software, check the quality of all data in the resulting data file(s), and then deliver the file(s) to VRC on diskettes in mutually agreed data format.

2. Two of the fifteen data fields contained in the current NSFR Parcel File Data Sheet are to be revised as follows:

a. "Cluster (x of n)" to "No. of Cluster Parcels". This field is now to contain the number of parcels, i.e., parcel I.D. numbers, that contribute to the data in the record. For a single parcel, one would record "1" not "0". Never leave it blank. In fact, please leave no data fields blank. If data item is not observed, record a right justified "0" for not present.

b. "Total No. Bldgs. (xx.x)" to "Total No. Bldgs (actual total count)". The field records the total number of buildings found in the parcel or cluster. Unlike before, record the actual number of buildings found without "division by n".

3. Handling Clusters. Clusters are defined as before, but now only one record is to be encoded rather than one record for each parcel in the cluster, namely:

a. For "land" clusters, the encoded record is to contain data for the entire cluster, e.g., land area for Parcel Total field is to be for all the land covered by the cluster rather than for just one of the cluster's parcels. Also, in the "No. of Cluster Parcels" field simply record the number of parcels in the cluster. Other considerations are:

(i) the "Parcel I.D." field is to reflect the parcel ID of the parcel in the cluster that contains the predominant building(s); and

(ii) the "Func. Code" and "Const. Code" fields are to reflect the building(s) found in the "predominant" parcel.

b. For "air project" clusters, i.e., residential condominiums and so on, encode as if "land" cluster. If no land parcel I.D. number is given as in the case of Los Angeles County, record the first parcel I.D. number in the sequence. If a land parcel I.D. number is given as in the case of Orange County, record the land parcel I.D. number.

If you disagree with any of these changes, please call me right away before continuing. I look forward to seeing your first effort with these changes.

Regards,

Yuji Horie, Ph.D.
Principle Investigator

Appendix I: Street Survey Form

VRC STREET SURVEY

Date: ____/ ____/ '88

Route/Field I.D. No. _____ Odometer at Start _____

Surveyor's Name _____ Odometer at End _____

Driver's Name _____ Total Miles _____

Direction: [ ] Clockwise, [ ] Counterclockwise, [ ] Both Directions

Material/Item		BARE	PAINTED
STREET LIGHT	*Steel*		
	Concrete		
	Arm Only		
SIGNAL LIGHT	*Overhang*		
	Up-Right		
SIGN POST	*Metal Pole*		
	Grated Metal		
	Wooden Post		
OTHER	*Hydrant*		
	Mail Box		
	Reflector		
	Rail Rd X		

Curb _____ mi Metal Guardrail _____ mi

Sidewalk _____ mi Concrete Guardrail _____ mi

COMMENTS: _____

_____

Appendix J: Basinwide Material Surface by Infrastructure Type

(State Highways)

Material	Mat'l Factor	Total Area (SQ.FT.)
CHAIN LINK FENCE --	13,728,000 Ft.	
C. L. Fence	6.0	82,368,000
FWY INTERCHANGE - T TYPE -- 16		
Concrete	113900.0	1,822,400
Gal. Steel	7400.0	118,400
FWY INTERCHANGE - X TYPE -- 34		
Concrete	227600.0	7,738,400
Gal. Steel	15600.0	530,400
FWY INTERCHANGE - Y TYPE -- 15		
Concrete	75900.0	1,138,500
Gal. Steel	4400.0	66,000
GUARDRAIL - CONCRETE -- 3,474,240 Ft.		
Concrete	4.0	13,896,960
GUARDRAIL - METAL -- 2,919,840 Ft.		
B. Metal	2.7	7,883,568
B. Wood	1.2	3,503,808
ON/OFF RAMP SIGNS -- 4,228		
B. Wood	15.5	65,534
Pt. Metal	27.1	114,579
ONE POST SIGN -- 3,207		
B. Metal	194.0	622,158
Pt. Metal	128.0	410,496
OVER/UNDER PASS -- 1455		
Concrete	14550.0	21,170,250
Gal. Steel	1280.0	1,862,400
SHOULDER REFLECTOR -- 136,895		
Gal. Steel	3.4	465,443
Pt. Metal	.5	68,448
SIGN ATTACHED TO BRIDGE -- 774		
Pt. Metal	114.0	88,236
STREET LIGHT - B. STEEL -- 25,832		
B. Aluminum	6.3	162,742
Gal. Steel	52.6	1,358,763
Glass	.8	20,666
Pt. Steel	3.0	77,496
TWO POST SIGN -- 950		
B. Metal	548.0	520,600
Pt. Metal	384.0	364,800

Material	Mat'l Factor	Total Area (SQ.FT.)
CURB -- 251,100,960 Ft.		
Concrete	1.1	276,211,056
GRATED METAL POST - B. -- 260,786		
Gal. Steel	6.3	1,642,952
Pt. Metal	4.5	1,173,537
GRATED METAL POST - PT. -- 7,440		
Pt. Gal. Steel	6.3	46,872
Pt. Metal	4.5	33,480
GUARDRAIL - CONCRETE -- 506,880 Ft.		
Concrete	4.0	2,027,520
GUARDRAIL - METAL -- 1,362,240 Ft.		
B. Metal	2.7	3,678,048
B. Wood	1.2	1,634,688
HYDRANT - PT. -- 134,648		
Pt. Metal	9.4	1,265,691
MAIL BOX - PT. -- 11,084		
Pt. Metal	25.5	282,642
RAILROAD CROSSING -- 1,572		
Gal. Steel	14.3	22,480
Glass	3.6	5,659
Pt. Metal	28.4	44,645
Pt. Wood	22.0	34,584
SHOULDER REFLECTOR -- 11,012		
Gal. Steel	3.4	37,441
Pt. Metal	.5	5,506
SIDEWALK -- 194,515,200 Ft.		
Concrete	5.3	1,030,930,560
SOLID METAL POST - B. -- 327,612		
Gal. Steel	7.3	2,391,568
Pt. Metal	6.2	2,031,194
SOLID METAL POST - PT. -- 17,284		
Pt. Gal. Steel	7.3	126,173
Pt. Metal	6.2	107,161
STOP LIGHT - B. OVERHANG -- 41,560		
Gal. Steel	62.8	2,609,968
Glass	2.6	108,056
Pt. Metal	64.6	2,684,776

Material	Mat'l Factor	Total Area (SQ.FT.)
STOP LIGHT - B. UPRIGHT --	29,964	
Gal. Steel	16.7	500,399
Glass	3.6	107,870
Plastic	60.5	1,812,822
Pt. Metal	39.3	1,177,585
STOP LIGHT - PT. OVERHANG --	1,820	
Glass	2.6	4,732
Pt. Gal. Steel	62.8	114,296
Pt. Metal	64.6	117,572
STOP LIGHT - PT. UPRIGHT --	5,784	
Glass	3.6	20,822
Plastic	.9	5,206
Pt. Gal. Steel	16.7	96,593
Pt. Metal	39.3	227,311
STREET LIGHT - ARM ONLY --	195,032	
B. Aluminum	6.3	1,228,702
Gal. Steel	18.8	3,666,602
Glass	.8	156,026
STREET LIGHT - B. STEEL --	82,716	
B. Aluminum	6.3	521,111
Gal. Steel	52.6	4,350,862
Glass	.8	66,173
Pt. Steel	3.0	248,148
STREET LIGHT - CONCRETE --	384,805	
B. Aluminum	6.3	2,424,272
Concrete	45.8	17,624,069
Gal. Steel	3.1	1,192,895
Glass	.8	307,844
Pt. Steel	3.0	1,154,415
STREET LIGHT - PT. STEEL --	69,894	
B. Aluminum	6.3	440,332
Gal. Steel	3.1	216,671
Glass	.8	55,915
Pt. Steel	52.5	3,669,435
WOODEN POST - B. --	57,984	
B. Wood	9.5	550,848
Pt. Metal	7.0	405,888
WOODEN POST - PT. --	83,424	
Pt. Metal	7.0	583,968
Pt. Wood	9.5	792,528

Material	Mat'l Factor	Total Area (SQ.FT.)
LARGE FLOOD CHANNEL -- 607,200 Ft.		
B. Concrete	100.0	60,720,000
C. L. Fence	18.0	10,929,600
RAILROAD -- 2,872,320 Ft.		
B. Steel	4.0	11,489,280
SMALL FLOOD CHANNEL -- 1,948,320 Ft.		
B. Concrete	50.0	97,416,000
C. L. Fence	18.0	35,069,760

(Transmission Network)

Material	Mat'l Factor	Total Area (SQ.FT.)
DISTRIBUTION POLE --	1,389,861	
Creosote Wood	180.0	250,174,980
Gal. Steel	5.3	7,366,263
SUBSTATION -- 833		
Gal. Steel	11200.0	9,329,600
Pt. Steel	6060.0	5,047,980
TRANSFORMER -- 555,944		
Gal. Steel	6.8	3,780,419
Pt. Steel	28.3	15,733,215
TRANSMISSION POLE --	166,667	
Creosote Wood	267.0	44,500,089
Gal. Steel	17.0	2,833,339
TRANSMISSION TOWER --	27,778	
Gal. Steel	2240.0	62,222,720